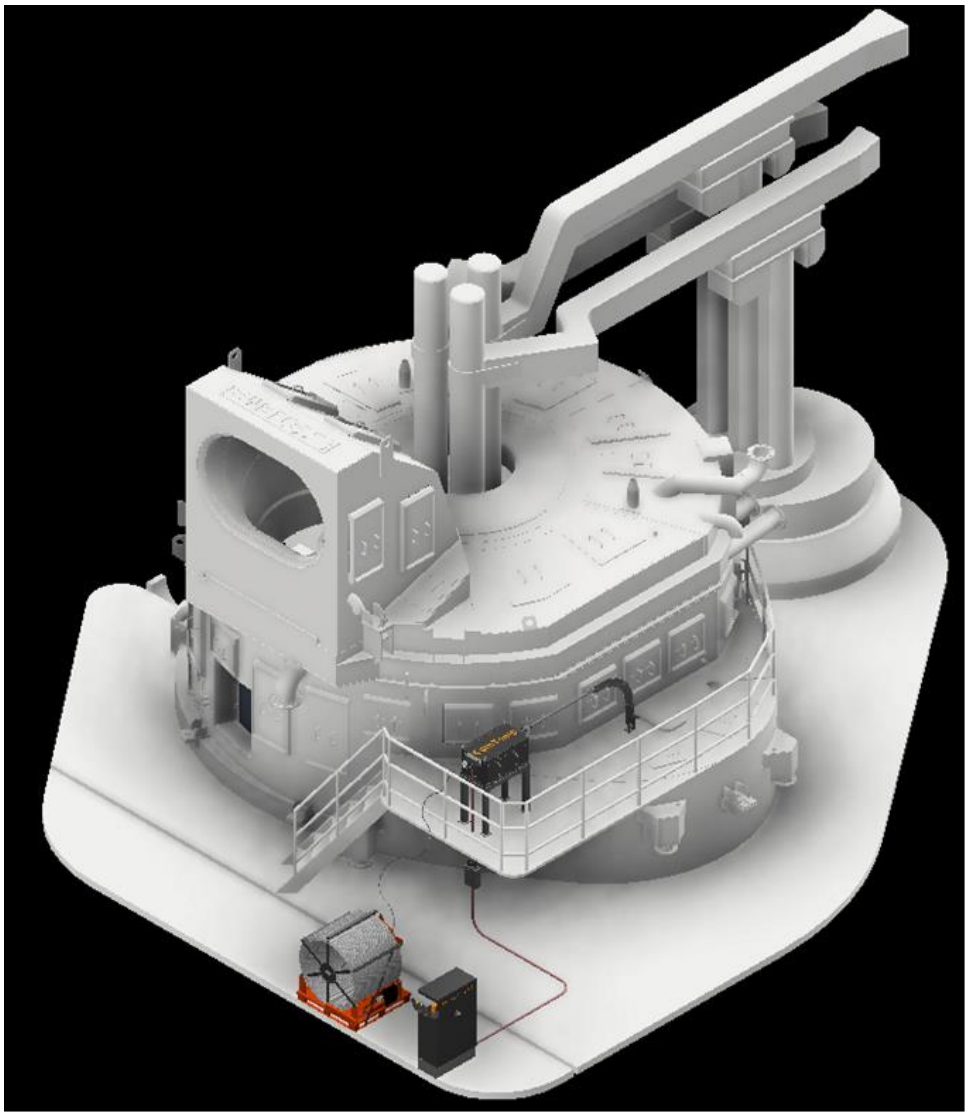
Heraeus

Instruction and Operating Manual

CoreTemp



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Original instruction

Improvements or instrument changes added after this document was printed are to be found on one or more pages enclosed at the end of this manual. We ask you to take note of these extra sheets.

All instrument boards contain electronic components that can be damaged by electrostatic discharge. These boards should only be handled by qualified personnel. The necessary safety precautions and security guidelines must be observed during maintenance and service on the instrument.

Table of contents

1 Introduction

1.1 Document Identification

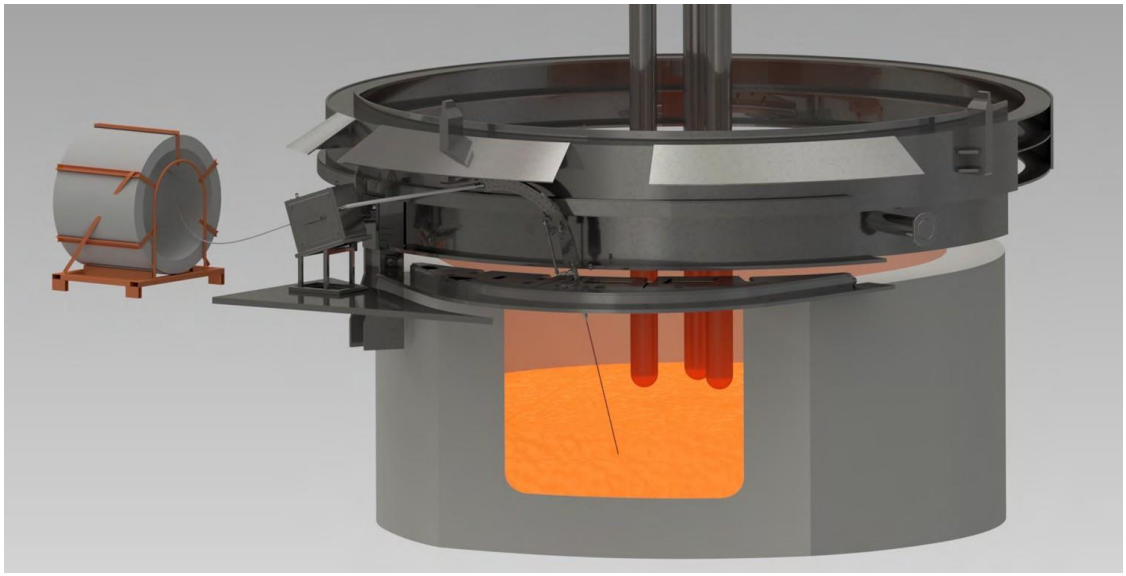
This manual provides information required to use and maintain the CoreTemp system. It is written for technically skilled personnel such as engineers, programmers, or maintenance specialists who have been specially trained and who have the specialized knowledge required in the field of instrumentation, electronics, and control.

This manual is an integral part of the instrument or device. For the sake of clarity, not all details of all versions of the instrument or device are described, nor can it cover all conceivable cases regarding installation, operation, and maintenance. If you require further information or face special problems that have not been dealt with in sufficient detail in this manual, contact your local Heraeus Electro-Nite representative.

We would also point out that the contents of this manual shall not become a part of, or modify, any prior or existing agreement, commitment, or legal relationship. The Purchase Agreement contains the complete and exclusive obligations of Heraeus Electro-Nite. Any statements contained in this manual do not create new warranties or restrict the existing warranty.

1.2 General Description

The CoreTemp instrument is an automated, optical fiber-based measuring system capable of delivering accurate temperature readings of liquid steel during the operation of electric furnaces. The instrument is developed to withstand the harsh environment around the electric arc furnace. With an optical fiber, a stable temperature is quickly detected and sent to the plant PLC to be displayed on the user interface. A semi-continuous temperature profile helps the operator accurately define the desired end point of each melting cycle. Manless operation is achieved by remote control of the CoreTemp system from the safety of the control room.



2 Safety and Usage Notes

2.1 Skilled Personnel

Only skilled personnel should be allowed to work on this instrument or device. Non-compliance with the warnings contained in this manual or appearing on the instrument or device itself can result in death or severe personal injury or damage to property. Skilled personnel include:

- System planning and design engineers who are familiar with the safety concepts of automation equipment, instruments, or electronic devices.
- An engineer who can calculate the strength of the structure to mount the installation if necessary.
- Operating personnel who have been trained to work with automation equipment, instruments, or electronic devices, and are conversant with the content of the manual in as far as it relates to the actual operation of the instrument or device.
- Commissioning and service personnel who are trained to repair such automation equipment, instruments, or electronic devices, and who are authorized to energize, de-energize, clear, ground, and tag circuits, equipment, and systems in accordance with established safety practices.

2.2 Danger Notices

The notices and guidelines that follow are intended to ensure personal safety, as well as protecting the instrument or device and any connected equipment against damage.

The safety notices are warnings for protection against loss of life (yours or service personnel) or for protection against damage to property and are highlighted in this manual by the terms and pictograms defined here. The terms used in this manual and marked on the instrument or device itself have the following significance:

Danger: Indicates that death, severe personal injury, or substantial property damage will result if proper precautions are not taken.

Warning: Indicates that death, severe personal injury, or substantial property damage can result if proper precautions are not taken.

Caution: Indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note: Indicates important information about the product, its operation, or a part of the manual to which special attention is drawn.

Attention: Hints in this documentation to special safety-related guidelines, which equate to the safety level of Caution and Note.

	This pictogram is intended to alert the user to the presence of important operating and maintenance (servicing) instructions on the literature accompanying the instrument or device. This pictogram is used in relation to **Danger**, **Warning**, and **Caution** notices.

2.3 Proper Usage

The instrument or instrument components may only be used for the applications described in the manual or the technical description, and only in combination with the equipment, components, and devices of other manufacturers as far as this is recommended or permitted by Heraeus Electro-Nite.

The instrument described has been developed, manufactured, tested, and the manual compiled in keeping with the relevant safety standards. In addition to this some safety measures that must be taken care of by the user are defined in section 2.5. Consequently, if the handling instructions and safety guidelines described for planning, installation, operation, and maintenance are followed, the instrument or device, under normal conditions, will not be a source of danger to property or life.

According to the EMC directive Emissions Testing according to standard EN55032, the instrument passed Class A: Industrial use.

	**Warning:** When the equipment is used in a manner not specified by Heraeus Electro-Nite in this manual, the protection provided by the equipment may be impaired. **Caution:** This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments. **Note:** The instrument should only be operated from the control room except when changing the coil.

2.4 Risk Management

There are some residual risks that are not covered by the CoreTemp safety system. Consequently, the user is strongly advised to take some additional safety measures.

Note that Heraeus cannot identify every conceivable residual risk. For instance, many residual risks may be mitigated or addressed by following safety measures developed in accordance with OSHA or other health and safety regulatory guidelines. The following table sets forth a non-exhaustive list of some residual risks and safety recommendations that users might consider.

Residual risk	Reduction measures taken by Heraeus Electro-Nite	Recommended additional safety measures taken by the user
Crushing hazards during installation		Each component of the CoreTemp system needs to be fixed to a part of the steel plant's infrastructure. It must be carefully checked if the surface it's connected to is stable and sufficiently strong to carry the additional load. Strength calculations/test need to be made before activating the equipment. Ensure no personnel is in the vicinity of the equipment when performing strength tests of the installation and when feeding the first Cored Wire coil through the newly installed system.
Crushing hazards. Risk of injury due to movement of parts of the CoreTemp system during normal operation.	CoreTemp system provided with safety PLC. When activated the system will automatically go to manual mode.	Presence of personnel in vicinity of CoreTemp equipment during normal operation needs to be strictly prohibited or made impossible. Install the coil and feeder in an inaccessible fenced off area of which the entrance is connected to the CoreTemp system Safety PLC using the available safety contacts. The system will automatically go to manual mode when entrance is opened.
Crushing hazards. Risk of injury due to movement of parts of the CoreTemp system during lockout of the EAF systems	Lockout contact foreseen on the control unit and junction box.	The CoreTemp system should be included in the lock-out procedure of the EAF systems to prevent anyone from starting a measurement in automatic mode.
Risk of getting crushed when the Cored Wire coil is pulled from its position towards the feeder	End of coil detection by software installed	Install the coil and feeder in an inaccessible fenced off area of which the entrance is connected to the CoreTemp system Safety PLC using the available safety contacts. The system will automatically go to manual mode when entrance is opened. Cored Wire coil fixation or a mechanical barrier has to be put in place to prevent the coil from moving towards the feeder.
Risk of injury during coil replacement.		Install the coil and feeder in an inaccessible fenced off area of which the entrance is connected to the CoreTemp system Safety PLC using the available safety contacts. The system will automatically go to manual mode when entrance is opened. If this solution is not in place, ensure, before any action is taken in the vicinity of the CoreTemp system that the switch on the local control is put to into manual mode (action from control room made impossible). Feeding the Cored Wire into the furnace manually should only be done when the furnace lock-out has been removed.
Cut wounds. When cutting Cored Wire in pieces, take care of potential energy of Cored Wire. It might jump away after cutting. Take care of sharp edges.		Make suitable gloves and work clothing mandatory at the workplace. Use bolt cutter or handheld saw to cut the cored wire into pieces. Use of an angle grinder is not recommended. Use appropriate tools to remove plastic straps on a new coil of cored wire.

Residual risk	Reduction measures taken by Heraeus Electro-Nite	Recommended additional safety measures taken by the user
Risk of injury during maintenance of the CoreTemp system	CoreTemp system provided with safety PLC. When activated the system will automatically go to manual mode.	Automatic lock-out of CoreTemp system by usage of safety contact on door of fenced of area when working in the vicinity. If this solution is not in place, ensure, before any action is taken in the vicinity of the CoreTemp system that the switch on the local control is put into to manual mode (action from control room made impossible). In case of fenced off area, foresee enough space to move around equipment safely
Person getting injured, damage to hearing or dust getting blown into the area during working on compressed air lines or blowing lance.		Whenever working on compressed air system, ensure the supply valve to the Control Unit is closed and if possible, provide lock-out. When a separate air tube for the cooling is foreseen, this must be closed manually. Be careful when disconnecting air hoses, remaining pressure might be present even when Control Unit is locked out (between valve and Control Unit).
Crushing hazards. Risk of injury due to movement of parts of the CoreTemp system during maintenance on the EAF systems.		During lock-out of EAF systems, CoreTemp should be included in the lock-out procedure to prevent anyone from starting a measurement in automatic mode. Feeding the Cored Wire into the furnace manually should only be done after the furnace lock-out has been removed.
Electrical hazards	Risk of injury during coil replacement.	Install the coil and feeder in an inaccessible fenced off area of which the entrance is connected to the CoreTemp system Safety PLC using the available safety contacts, so that no personnel have the possibility to touch the CoreTemp equipment during furnace arcing. Coil replacement and blowing lance replacement only to be per- formed when EAF is locked-out and electrode is in safe parking position. During cleaning or maintenance around the CoreTemp system, the system must be locked-out at the Junction Box and no system components should be opened. Any maintenance or repair works require the CoreTemp system to be completely locked out at the Control Unit.
Instrument and cables are damaged		Protect the system as much as possible by placing the junction box in a protected area and placing the cables in protective tunnels to prevent damage. In case cable gets damaged, cable must be replaced immediately after locking out the CoreTemp system. Check fuses.

2.5 Transport

Report damage during or immediately after delivery to the transport company and to Heraeus Electro- Nite. Take all necessary steps to prevent further damage.

Caution: All local regulations need to be followed concerning lifting heavy loads. The CoreTemp is too heavy to lift by hand. Use mechanical aids.

2.5.1 Packaging of the Instrument

Since the instrument or device is a high-quality electronic measurement unit, it should only be dispatched in its original packing. If the original packing is no longer present, then it is advisable to properly pack the device in a sufficiently large box lined with a shock-absorbing material such as PUR foam, polystyrene flakes, or similar. The shock-absorbing layer should have a minimal thickness of 10cm on all sides. Before packing the instrument, it must be wrapped in paper or plastic film.

Anti-static packing material must always be used when storing and dispatching ESD-sensitive modules and components. If the container itself is not conductive, the modules must be wrapped in a conductive material such as conductive foam, antistatic plastic bag, aluminum foil, or paper. Normal plastic bags or foil should not be used under any circumstances. For modules with built-in batteries, ensure that the conductive packing does not touch or short-circuit the battery connections: if necessary, cover the connections with insulating tape or material.

For overseas transportation, the unit should be welded into an air-tight plastic film, ideally with a desiccant added. These packing recommendations also apply when returning the unit to Heraeus Electro-Nite.

2.6 Guidelines for Handling Electrostatic Discharge

VLSI chips (MOS technology) are used in practically all Heraeus Electro-Nite electronic modules. These VLSI components are, by their nature, very sensitive to over voltages and thus to electrostatic discharge (ESD).

This pictogram and warning label is used on cabinets, sub-racks, and packing and suggests that modules are susceptible to ESD.
Before starting maintenance or installation make sure that you have sufficient protection against ESD.

Electronic devices can be destroyed by voltage and energy levels that are far below the level perceptible to human beings. Such voltages can occur when a component or a module is touched by a person who has not been electrostatically discharged. In most cases, the components subjected to such over voltages, cannot be immediately detected as faulty. The fault occurs only after a long period in operation.

2.7 Restriction of Hazardous Substance (RoHS) Regulations

All electrical devices sold in the European market from the July 1, 2006, must comply with EU Directive 2002/95/EC, and RoHS 2 directive 2011/65/EU, on the Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) as well as the national laws derived from it. According to the definition in Annex I of EU Directive 2012/19/EU WEEE, Heraeus Electro-Nite measuring instruments and analysis devices belong to category 9 – industrial monitoring and control instruments.

All Heraeus Electro-Nite instruments placed on the market after 1 July 2006 do not contain materials prohibited according to the RoHS directive.

Affected parts and components are identified and adapted to the statutory requirements and other substances in those parts and components are utilized where necessary. The quality and usability of our devices are not affected. The adaptations are usually not visible, although adapted primary housing parts can show different surface color.

2.8 Waste Electrical and Electronic Equipment (WEEE) Regulations

According to the EU Directive 2012/19/EU Waste Electrical and Electronic Equipment (WEEE), all electrical devices sold in the European market from the 13 August 2005 must be marked with a special symbol. This symbol (crossed out waste disposal receptacle with thick black bar underneath) indicates to the customer that the device must not be placed in household waste but must be either deposited at a collection place for commercial scrap or returned to the manufacturer.

Heraeus Electro-Nite devices are exclusively for commercial use and may not be transferred to private use. Devices must be disposed of according to the national, statutory regulations for commercial electrical scrap. You must also follow the EU Directive WEEE regulations and their national conversion. If in doubt, ask your local Heraeus Electro-Nite representative.

2.9 Disposal of Instrument or Parts

If the instrument must be discarded, think about the following recycling issues. The device consists of several components that can be disposed of separately:

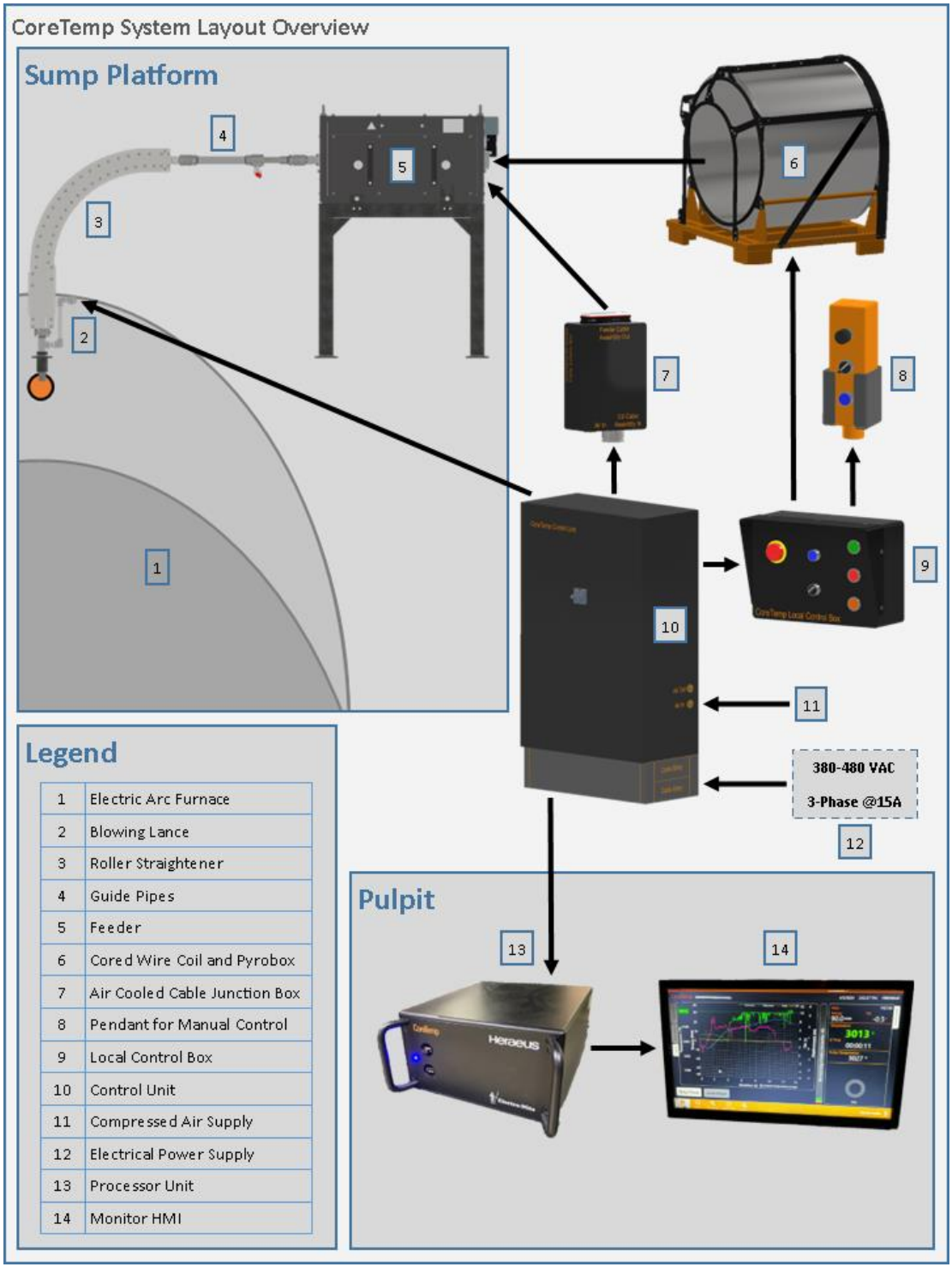
- The electronic cards for electronic recycling
- The housing for metal recycling

For further disposal information, follow the local legislation.

3 System Description

3.1 Different components

The CoreTemp instrument measures the temperature of liquid steel during the operation of electric arc furnaces (EAF). The measurements are taken using a cored wire containing an optical fiber. The wire is fed semi-continuously into the EAF by the wire feeder. The system is operated from the control room through a PLC control unit. A remote display is available for the operator to control measurements from the control room and visualize the results.



3.2 Analysis Technique

The CoreTemp makes use of an optical fiber to determine the temperature of steel in either an EAF, Consteel or ladle. Temperature is determined by applying Planck's law of radiation, as shown in the equation below, to the measured emitted light intensity:

$$B_\lambda(\lambda, T) = \frac{2hc^2}{\lambda^5} * \frac{1}{e^{hc/(\lambda k_B T)} - 1}$$

λ = wavelength
k_B = Boltzmann constant
h = Planck constant
c = speed of light in the medium

Planck's law states that for a given fiber cross section and exposure time a unique temperature corresponds to the measured emitted light intensity. The emission intensity is determined at 1550 nm (chosen for minimal signal attenuation in the fiber). The emissivity = 1 when fully submerged in the black body.

In the CoreTemp system the light is transmitted throughout the whole length of the coil to end up at the pyrometer box. The pyrometer box converts the measured light intensity into a micro-voltage. This micro-voltage is converted into a temperature using the calibration factor determined during the calibration process. The temperature is displayed on the operator screen on the PC.

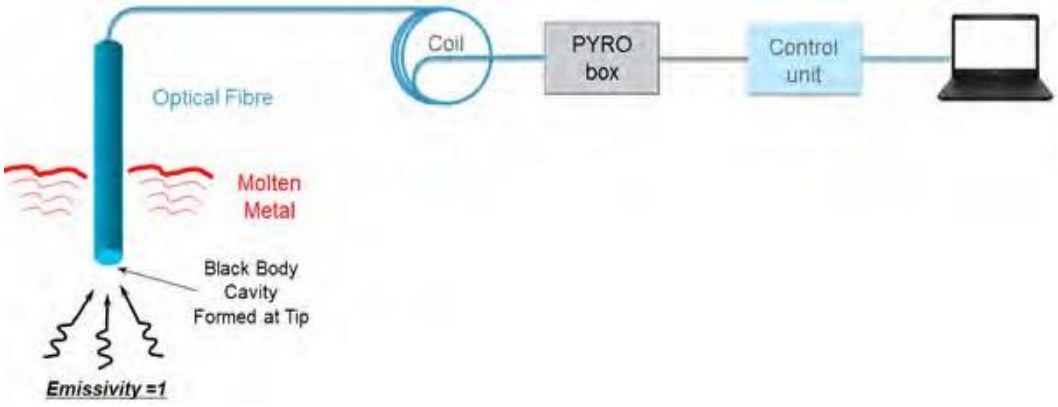


Figure 2: Analysis technique

3.3 Calibration of the CoreTemp Coil

All CoreTemp coils are calibrated by HEN prior to shipping.
The calibration process in short:

1. A master pyrobox is aligned by comparing optical fiber measurements to thermocouple measurements taken in steel in an induction furnace over a temperature range from 1560°C to 1700°C.
2. The pyrobox is attached to the CoreTemp coil.
3. Using a stable light source measurements are compared to the master pyrobox.
4. The pyrobox is then cut from the CoreTemp coil leaving only a short remanent of optical fiber attached to the pyrobox.
5. The pyrobox without the coil is compared to the master pyrobox using the stable light source.
6. These measurements are used to calculate the attenuation across the coil.
7. The pyrobox is again attached to the CoreTemp coil. Measurements of a stable light source are compared to the master pyrobox.
8. These measurements are used to align the coil with the master pyrobox.

4 Technical Data

Item	Description
Measurement application	Temperature measurement in Electric Arc Furnace.
Measurement channel	One analog input
Sample rate	50 samples/second
Measurement ranges	1500 to 1700°C (752 to 3092°F)
Accuracy	STDEV of 5°C over the coil length
Display resolution	1°
Display units	°C or °F
Power supply	380/480V 3phases 50/60Hz
Compressed air	3 to 8 bar
Air flow	2000 l/min blowing lance (max 5000 l/min), 800 l/min feeder

5 Hardware Overview

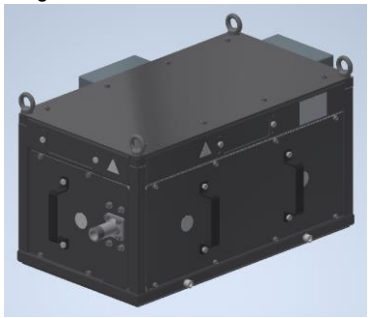
5.1 Cored Wire Coil

The CoreTemp optical cored wire contains an optical fiber inside that is used to measure temperature in the molten metal. The cored wire is packaged on coils that contain a certain length of cored wire. On the coil is placed a pyrometer box which connects to the junction box and control unit through the pyro cable.

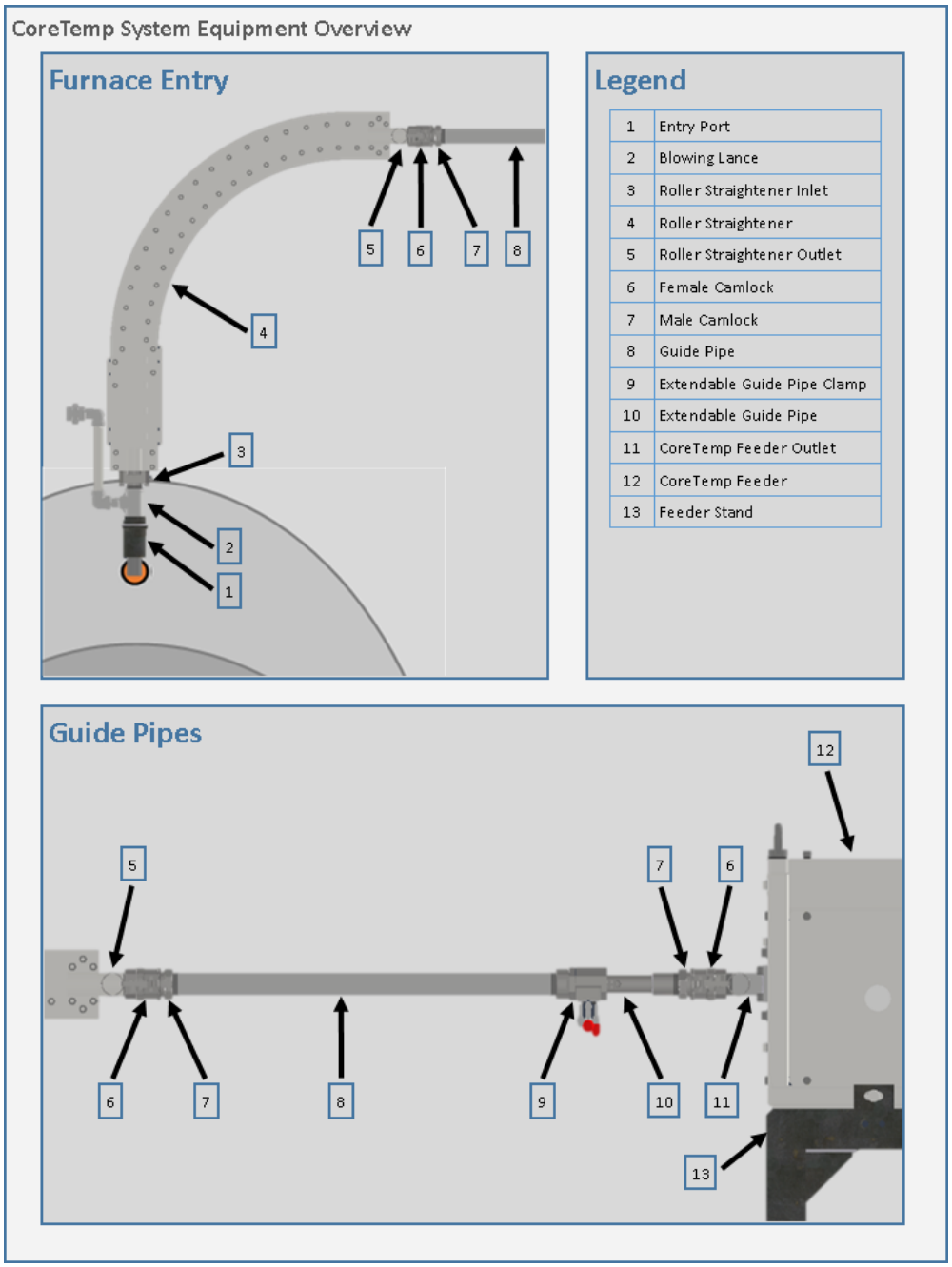
Item	Description
Power supply	24V DC
Operating ambient temperature range	0 (32°F) to 40°C (104°F)
Operating humidity range	max. 90% RH non-condensing
Operating altitude	Up to 2000m
Size	Height = 1350 mm; Width = 1250 mm; Depth = 1000 mm 
Weight	355kg (1 km wire) or 700 kg (2 km wire)
Dust/moisture protection class	Pyrobox: IP 65

5.2 Feeder

The cored wire feeder is a wire feeder with a servomotor. The motor is driven by the control unit software. The internal gears push the fiber at a certain speed into the furnace through the guide tubes and blowing lance.

Item	Description
Power supply	308 V, 3 phases, f=VAR
Operating ambient temperature range	0 (32°F) to 40°C (104°F)
Operating humidity range	max. 90% RH non-condensing
Operating altitude	Up to 2000m
Size	Height = 600 mm; Width = 500 mm; Depth = 1050 mm 
Weight	450 kg
Dust/moisture protection class	Motor inside the feeder: IP65

5.3 Guide Tube Assembly



5.3.1 Guide Tubes

5/4” SCH40 Stainless steel tubes.

5.3.2 Straightener

To direct the cored wire at the right angle into the EAF a straightener is placed before the blowing lance.

5.3.3 Blowing Lance

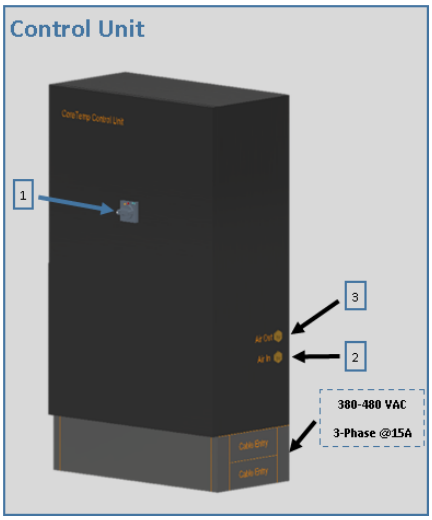
The blowing lance is the entry point for the CoreTemp sensor into the furnace through the wall of the EAF. Compressed air is blown through the lance to ensure the entry point for the cored wire into the furnace stays open.

5.4 Control Unit

This unit controls all movements (Siemens PLC and motor drive), safety functions (PILZ safety PLC) and other actions of the system:

- Communication with coil and driving feeder through the Junction Box
- Communication with control room PC by LAN cable
- It contains the pneumatic box with compressed air pressure, flow sensor, and regulator.

Item	Description
Power supply	380/480V, 3 phases, 50/60Hz
Operating ambient temperature range	0 (32°F) to 40°C (104°F)
Operating humidity range	max. 90% RH non-condensing
Operating altitude	Up to 2000m
Size	Height = 1400 mm; Width = 800 mm; Depth = 400 mm
Weight	109 kg (packaging 60 kg)
Dust/moisture protection class	IP65

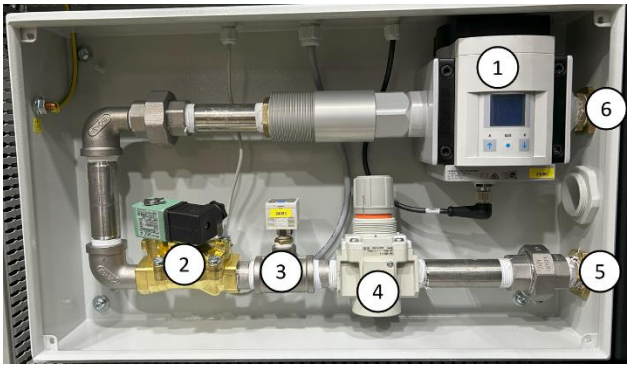


#	Component
1	Control Unit Power Switch
2	Blowing Lance Supply Air In
3	Blowing Lance Supply Air Out

Caution: Please make sure that the CoreTemp Control Unit is mounted on a safe and accessible position to enable safe operation. Decoupling the power of the instrument should always happen on a secure and accessible location.

5.4.1 Pneumatic Box

#	Component
1	Air Flow Meter
2	24VDC Pneumatic Valve
3	Air Pressure Sensor
4	Air Regulator
5	Air Supply IN
6	Air Supply OUT



5.5 Local Control Box

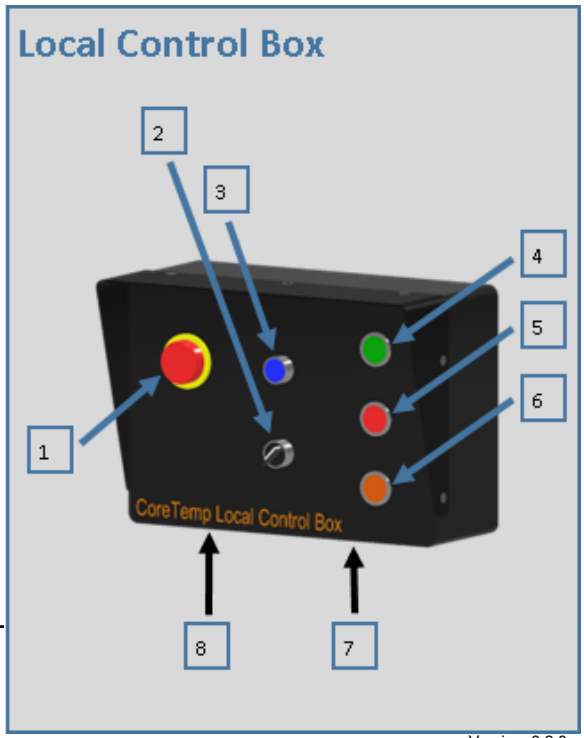
The local control box allows in manual mode safe manual movements of the Cored Wire (other than measurements started from the control room). When put in manual mode it guarantees safety of the operator in vicinity of the system because operations from the control room are disabled. When the auto-manual switch is set to auto and there is no error, measurements from the control room can be started again.

It also contains an emergency stop and a reset button that can be used to reset errors that might occur during operation.

It is connected to the Control Unit with a protected cable.

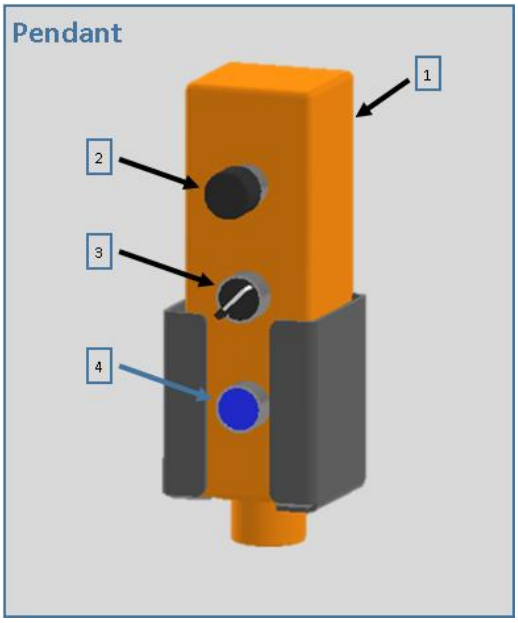
Item	Description
Power supply	24V DC
Operating ambient temperature range	0 (32°F) to 40°C (104°F)
Operating humidity range	max. 90% RH non-condensing
Operating altitude	Up to 2000m
Size	Height = 305 mm; Width = 432 mm; Depth = 204 mm
Weight	6 kg
Dust/moisture protection class	IP 65

#	Name	Function
1	Emergency Stop Button	Lockable emergency stop button
2	Auto/Manual Control Switch	Switch to select operation mode
3	Safety Reset Button / Blue Light	Error reset button
4	Green Light	the system is ready to measure
5	Orange Light	manual mode (intermittent)
6	Red Light	safety error (solid)
7	Pyro Cable Connector	Connection to Coils
8	Pendant Connector	Connection to Local Control Pendant



5.5.1 Pendant Control

Item	Description
Power supply	24V DC
Operating ambient temperature range	0 (32°F) to 40°C (104°F)
Operating humidity range	max. 90% RH non-condensing
Operating altitude	Up to 2000m
Size	Height = 229 mm; Width = 77 mm; Depth = 77 mm
Weight	3 kg
Dust/moisture protection class	IP 66



#	Name	Function
1	move button	movement can be actuated by pressing and holding the move button
2	direction switch	switch for manual movement reverse and forward
3	emergency stop mushroom head	perform an emergency stop
4	reset push button	reset system in case of safety error or malfunction (blue light)
5	AUTO / MANUAL switch	switch for automatic (AUTO) or manual (MANUAL) control. in automatic mode the system reacts on automatic process only in manual mode the system reacts on manual controls only

5.6 Processor Unit

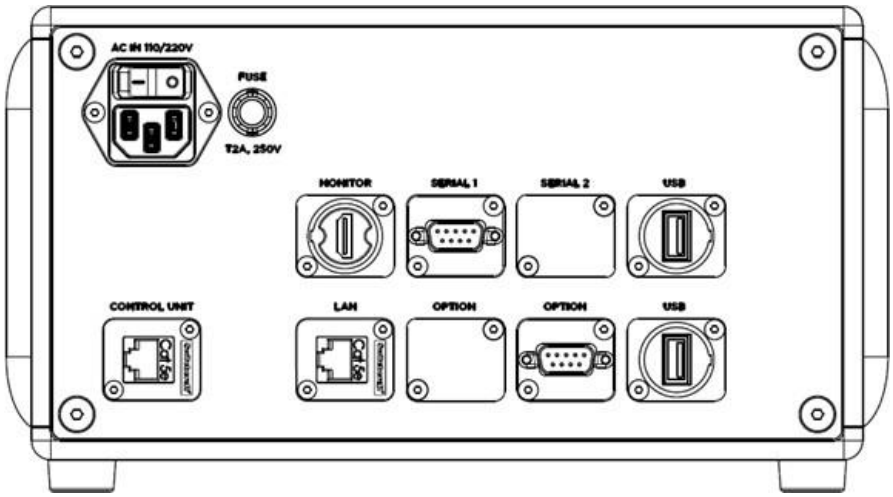
The processor unit runs the CoreTemp application software (server + main client). It allows multiple client connections (e.g. from HMI) and connects to the steel plant's level 2 network. It is delivered with an external 23.8" inch Full HD HDMI monitor and USB keyboard and mouse.

Item	Description
Power supply	100-240VAC, 50-60Hz, 1.6-0.9A Internal fuse: 2A time lag 250V
Power rating	25W max
Operating ambient temperature range	-10°C to +60°C
Operating humidity range	5 to 95% RH non-condensing
Operating altitude	Up to 2000m
Size	Height = 152.89 mm; Width = 278.76mm; Depth = 362.86mm

Weight	7 kg

⚠	**Caution:** Please make sure that the CoreTemp processor unit is mounted on a safe and accessible position to enable safe operation. Decoupling the power of the instrument should always happen on a secure and accessible location.

5.6.1 In- and Outputs Processor Unit



6 Hardware Installation

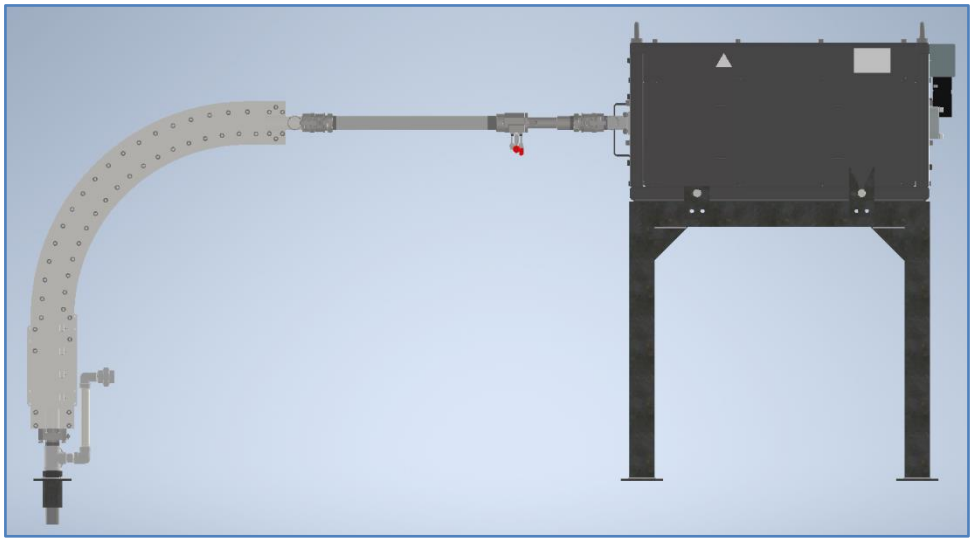
⚠	**Warning:** • All local regulations need to be followed concerning lifting heavy loads. Most CoreTemp equipment is too heavy to lift by hand. Use mechanical aids. • All safe work procedures must be followed when working at height. Scaffolding or cherry picker is recommended, if not possible, ensure 3-point contact when using ladder and/or wear a safety harness. • Provide enough lighting when working on the instrument. • For IT networks: make sure there is permanent isolation monitoring.

6.1 Where to Install the System

Since the installation of the CoreTemp system depends on the furnace configuration, contact your local Heraeus Electro-Nite sales representative for more information about a custom installation.
Strictly follow their instructions for installation, maintenance, and repairs. General installation rules:

- Control unit: at a safe place within 50m of the feeder with room temperature as stated in technical information.
- Feeder: located on the tilting platform of the furnace.
- Local Control Junction box close to the cored wire coil and the feeder.
- Cables connecting the different parts of the system should be placed in conduit when possible.
- Guide tubes between the feeder and the blowing lance: application dependent.
- Straightener connected at the blowing lance and sized to fit at or below the bezel ring of the furnace.
- Blowing lance: through the furnace sump panel, dependent on the configuration of the furnace.

The next drawing shows a detail of the installation of the feeder, guide pipe, straightener and blowing lance.



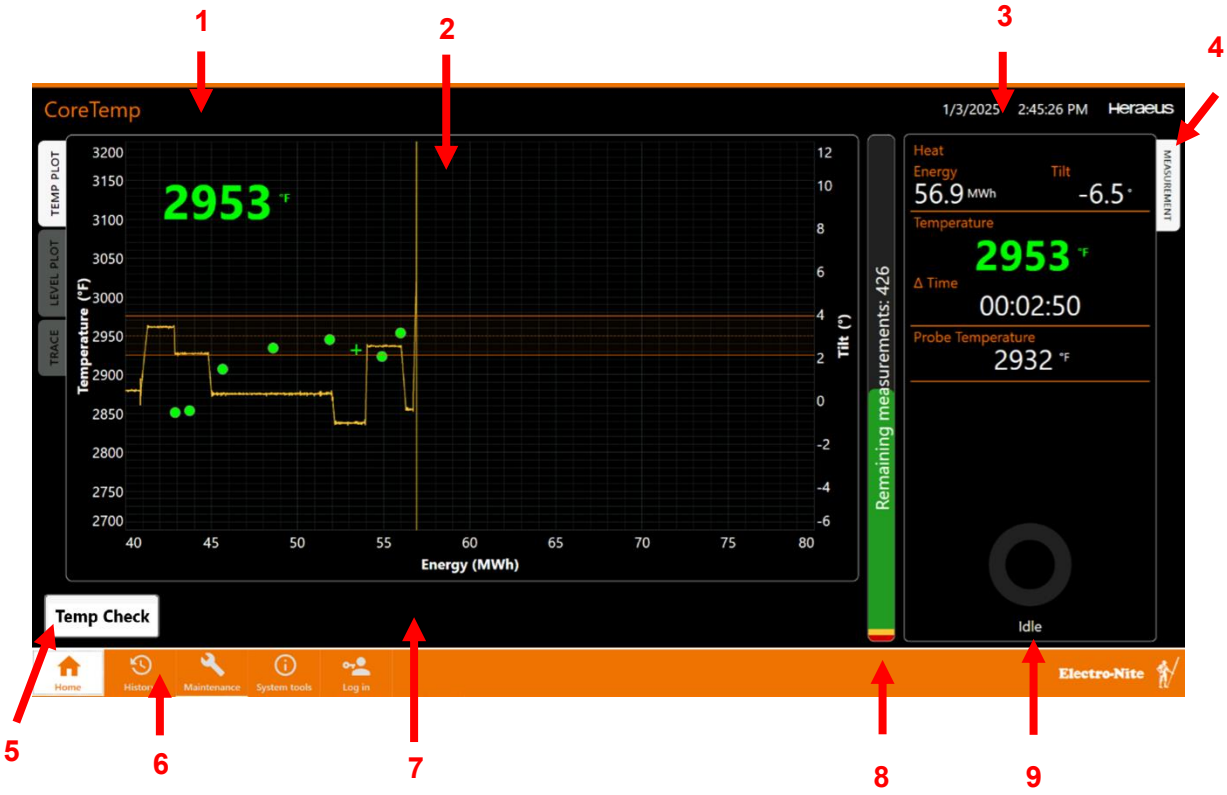
6.2 Requirements for External Connections

Power Supply	**380/480V 3phases 50/60Hz,15Amp supply line**
Compressed Air Supply	An air water separator with an automatic drain must be installed on the compressed air supply line.
	Minimum dedicated ¾" supply line from a 1" or larger header at 7bar/100psi. Open system regulated to 4bar/60psi for the blowing lance. Open system regulated to 1-3bar/20-40psi for cooling the feeder.
	Minimum air consumption of 2000L/ min (70SCFM) is used to keep the blowing lance open. Approximately 200L/min (7SCFM) is used for cooling the feeder.
Network requirements	The plant must foresee a direct network connection between the control unit and the processor over Ethernet or Fiber with media converters

7 User Interface

The CoreTemp system is during operation remotely controlled from the control room. The main user interface is the monitor attached to the processor unit.
Only during coil replacement and other maintenance procedures the system will be operated with a local control (Section 11.3).

7.1 Home Screen Overview



#	Name	Function
1	customer information	9.1.2
2	chart area	8.2.1.1
3	date and time	9.1.1
4	side panel	8.2.1.2
5	measurement button area	8.1
6	navigation buttons (home, history, settings, maintenance, system tools, login)	8.2.3
7	error notification area	8.2.4
8	coil status bar	11.3.2.1
9	progress-status indicator	8.18.1

7.2 User Levels

There are multiple user levels which enable different access to the machine:

- operator (no password)
- engineer, supervisor, lab technician (2-4-4-8)
- service engineer (day password provided by your local Heraeus Electro-Nite contact)

To enter the supervisor or engineer interface login is required.

1. Click the Login button on the navigation bar
2. Login screen pops-up

3. Enter the password and then click Go
4. Extra button(s) will appear on the navigation bar

The following table gives an overview of the different menus and accessibility levels.

Menu	Operator	Supervisor
Home	x	x
History	x	x
History | Heat History	x	x
History | Trace History		x
Maintenance	x	x
Maintenance | Command Center		x
Maintenance | Coil	x	x
Maintenance | Coil | Active Coil		x
Maintenance | Coil | Coil History	x	x
Settings		x
Settings | General		x
Settings | General | Instrument		x
Settings | General | Customer info		x
Settings | General | Visualization		x
Settings | Parameters		x
Settings | Parameters | Coil		x
Settings | Communication		x
Settings | Communication | Level2		x
Settings | Communication | Level2 | Manual mode		x
System tools	x	x
System tools | About	x	x
System tools | Export database/logs		x

8 Operation

8.1 Performing a Measurement

To start a measurement, push the ‘Temp Check’ button on the home screen.

Depending on the overall configuration of the system other measurement type options might also be available (Level Check, Heel Check, Tapping, Single, Sequence).

After pushing the ‘Temp Check’ button, a measurement will be started, and the progress of the measurement is shown by the progress-status indicator on the bottom right. When the measurement is done, idle state of the progress-circle is shown in the side panel on the bottom right.

For questions regarding different measurement type configurations, contact your local Heraeus Electro-Nite engineer.

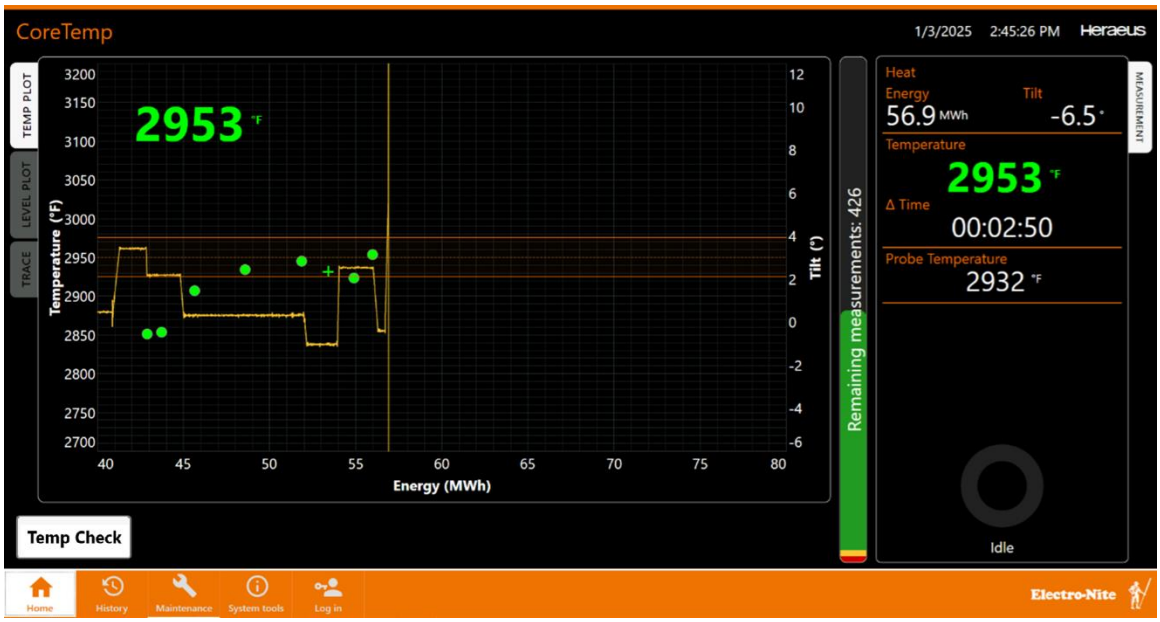
8.2 Evaluating the Results

8.2.1 Home Screen

8.2.1.1 Chart Area

Chart elements on the home screen:

- Last measured temperature is shown in the upper left corner in green.
  - *Estimated temperature (if available) is shown in white.*
- Individual measured temperatures (green dots)
- Trend line (if a trend line can be calculated from the measurements taken, a minimum of 4 green dots is required)
- The orange lines: heat temperature range min/max
- The blue dashed-lines: expected min/max end energy
  - *Only an estimated temperature profile is available.*



Axes on the operator screen:

- Temperature (y1-axis)
- Energy / Time: by default, the energy is shown.
- Tilt (optional) (y2-axis)

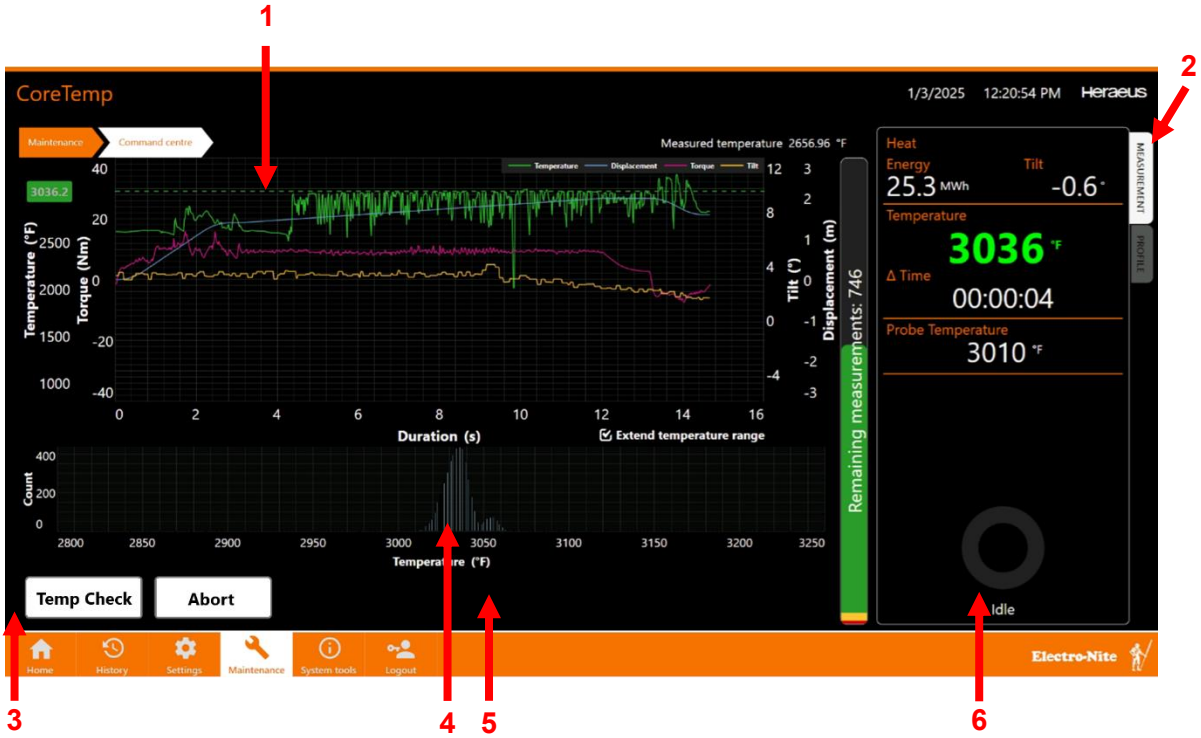
8.2.1.2 Side Panel

The side-panel will show a combination of live information, warnings and errors, and the latest measured results.

- Live elements like “Heat”, “Energy”, the “Tilt” of the furnace on top.
- Measurement results, last measured temperature in green and the estimated temperature in white.
- Time/Energy since the previous measurement
- Error and warning information during the measurements.
- Progress-status indicator when a measurement is ongoing.

8.2.2 Command Centre

If you login with the supervisor password you can see more details of the measurement in the command centre, click Maintenance > Command centre. The command centre is an advanced version of the home page, where a supervisor or engineer can follow each measurement live and if necessary, can abort an ongoing measurement.



#	Name	Function
1	live trace chart	graphical overview of the current or last measurement
2	side panel	displays the measured results
3	button area	“Single” and “Sequence” buttons to start measurements and “Abort” button to stop the measurement
4	live histogram chart	graphical history overview of the current or last measurement
5	error notification area	displays system errors and warnings
6	progress status indicator	displays the system status

8.2.2.1 Live Trace Chart

Chart elements on the live trace chart:

- Live temperature is shown on the graph (green line)
- Last calculated temperature is shown on the left side of the graph (green box with green dotted- line)
- The tilt of the furnace (yellow line => is only shown when the furnace has the option to tilt)
- Live torque is shown on the graph (Unit “Nm” - pink line)
- Live displacement is shown on the graph (Unit “m” - blue line)

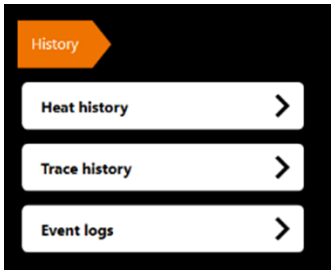
Axes:

- Temperature
- Tilt
- Torque (Nm)
- Displacement (m)
- Duration (min)

This chart can also be opened from the home screen, by clicking ‘Trace’ on the tab to the left of the chart.

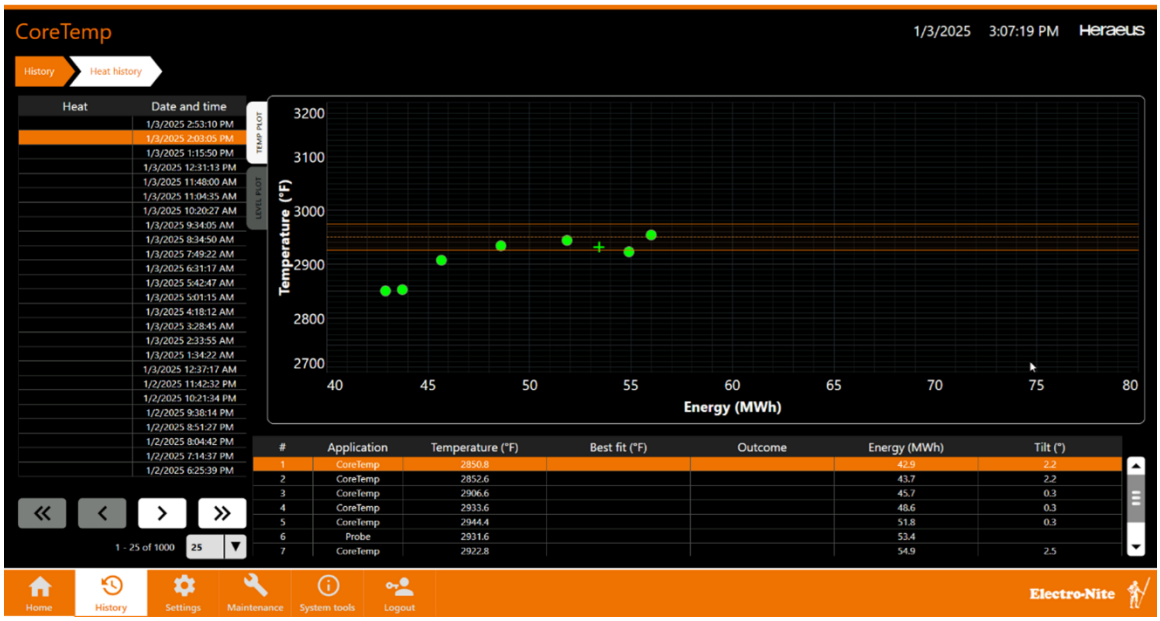
8.2.3 History Screen

The operator level has only access to the Heat history page. After login also the Trace history page can be viewed.



8.2.3.1 Heat History

All measurement results are stored in a database. On the ‘Heat history’ screen you can consult the results of previous heats stored in the database, details on temperatures measured and a snapshot of the graph.



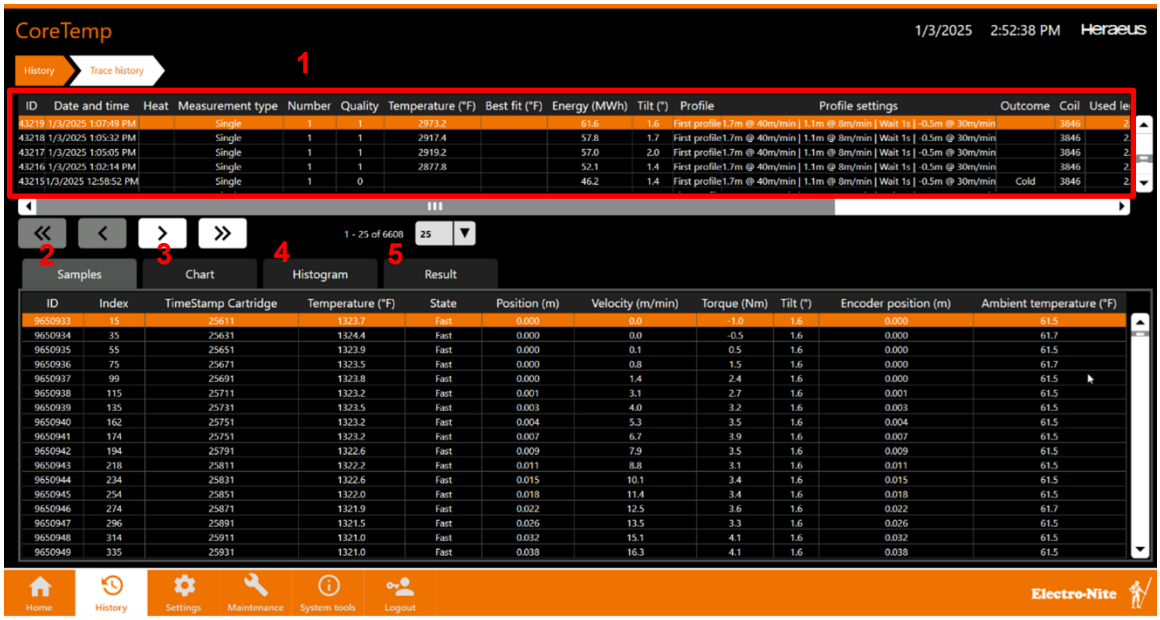
On the upper left corner in the heat overview select the heat you wish to see in detail.
Use the arrows on the bottom left corner to scroll through the different pages with measurement results.

The measurement overview (red rectangle) displays all measurements taken during the selected heat (ordered ascending)

- Measurement number (first measurement taken gets number 1, etc.)
- Temperature (the measurement is shown in the correct format °C or °F depending on the user settings)
- Outcome (In this column minor error information is shown like “Scrap”, “Cold”, etc.)
- Energy (this is always shown in MWh)
- Tilt (only shown if the furnace has the option to tilt)

8.2.3.2 Trace History

After login the supervisor engineer is able to view an advanced version of the history to get more insight and background information about measurements, samples and variables during a measurement.



1	measurement overview
2	samples tab
3	chart tab
4	histogram tab
5	result tab

The Measurement overview (red rectangle) displays all measurements taken, with the latest/newest on top (ordered ascending), and contains the following fields:

- ID (Unique measurement id)
- Date and time (The date-time should be formatted depending on the system setting)
- Heat (Heat number)
- Type (Measurement type: “Single”, “Sequence”, etc.)
- Number (Measurement number, like 1, 2, 3, etc.)
- Quality
- Temperature (the measurement is shown in the correct format °C or °F depending on the user settings)
- Furnace energy
- Tilt (°)
- Profile (First, second)
- Profile setting (like 1m@60m/min+0,5@5m/min+20wait+0,8m@60m/min)
- Outcome (In this column information is shown like “Scrap”, “Cold”, etc.)
- Coil (Name of the coil)
- Used length (M)
- External used length (M)
- Sub state error (Like motor-drive error nr, etc.)

In the Samples tab the user can find the individual samples of the selected measurement in the “Measurements overview”, and the samples overview will contain the following items/columns:

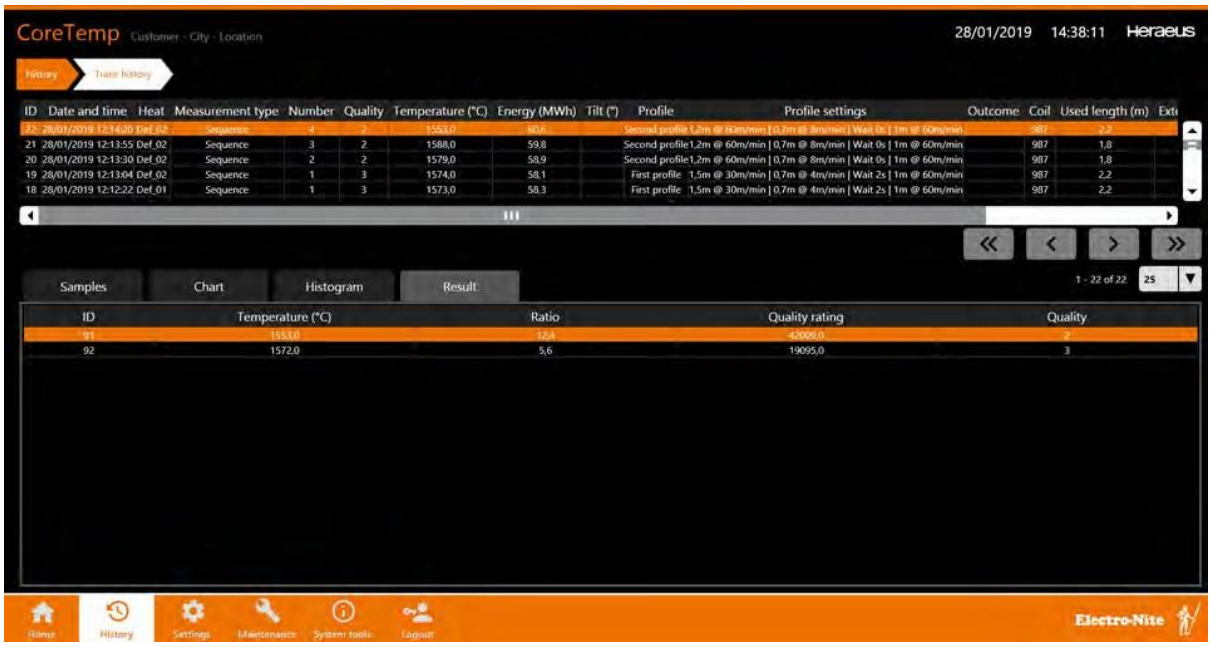
- ID (Unique sample id)
- Index (sample index number)
- Temperature (the measurement is shown in the correct format °C or °F depending on the user settings)
- State (like “Fast”, “Slow”, “Wait”, “Retract”)
- Position (m) (Motor position)
- Velocity (m/min) (Motor velocity)
- Torque (Motor torque)
- Tilt (°)
- Encoder position (Position of the external encoder)

The Chart tab will display the same graph as shown in the command-centre, this is of course based on the selected measurement in the “Measurements overview”.

On the Histogram, the supervisor can get a graphical overview of the algorithm calculations. The algorithm returns maximum 5 possible temperature points with their corresponding quality. In the Result view the user can consult these results.

This overview will contain the following fields:

- ID (Unique result id)
- Temperature (the measurement is shown in the correct format °C or °F depending on the user settings)
- Ratio
- Quality rating (calculated quality rating)
- Quality (like Q1, Q2 or Q3)



8.2.4 Measurement Errors

Measurement errors and warnings are shown on the side panel in a red square.

- The red square with the error can be clicked on to open a pop- up that gives more information

Error measurements will not remove the last measured temperature value or the estimated value if already present.

Error measurements will not influence the heat evolution. Depending on the type of error the sequence will be stopped or not.

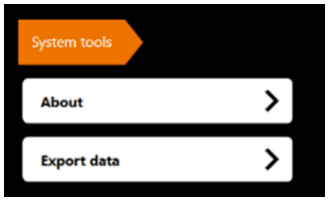
- If a measurement error occurs the measurement is not stopped (“NoEval”, “Cold”, “Minor scrap”)
- If a major error occurs the measurement will be stopped. (“Tracking Error”, “Motor Torque”, “Emergency stop”, etc.)

If there are multiple errors/warnings active

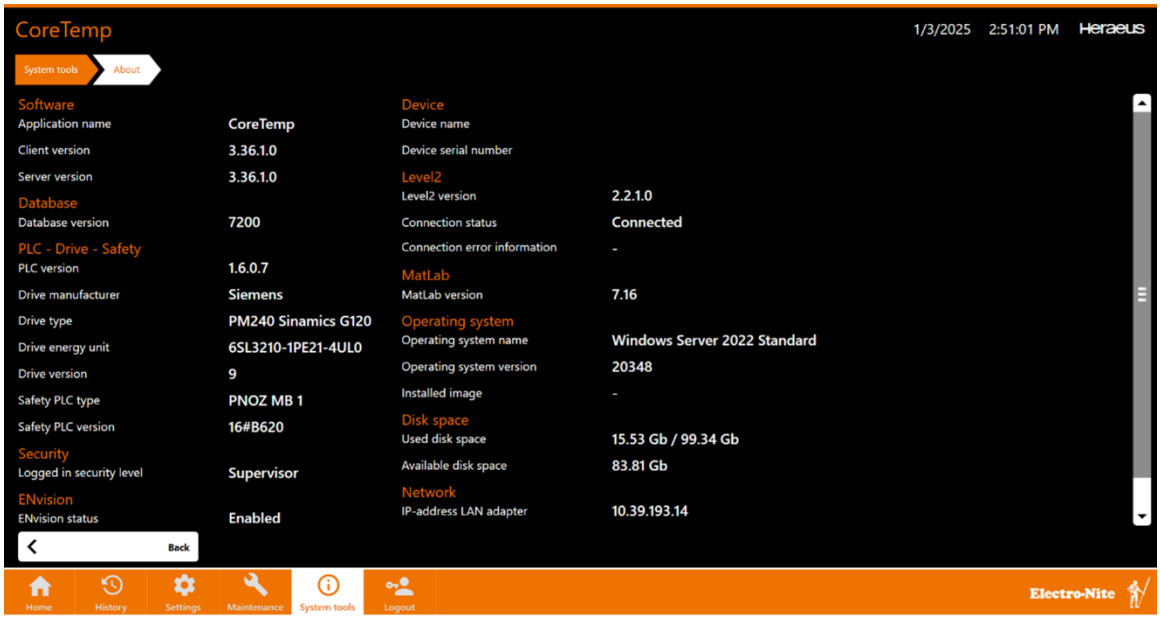
- The specific error text of the error with the highest priority is shown in the error notification area.
- An “x/y”-label and navigation buttons are shown in the pop-up screen.
- The error with the highest priority is by default shown as the first error.

8.2.5 System Tools (Software Version)

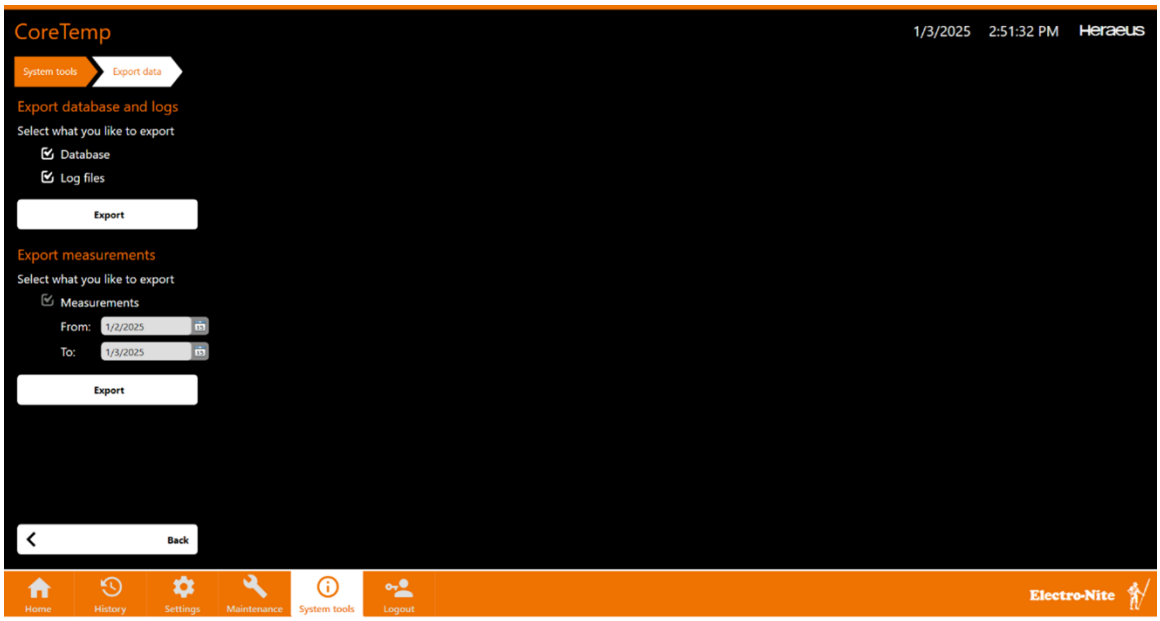
On the system tools screen the user can find information About the system and after login has the possibility to Export database.



The ‘About’ screen shows all information about the system, like version information etc.

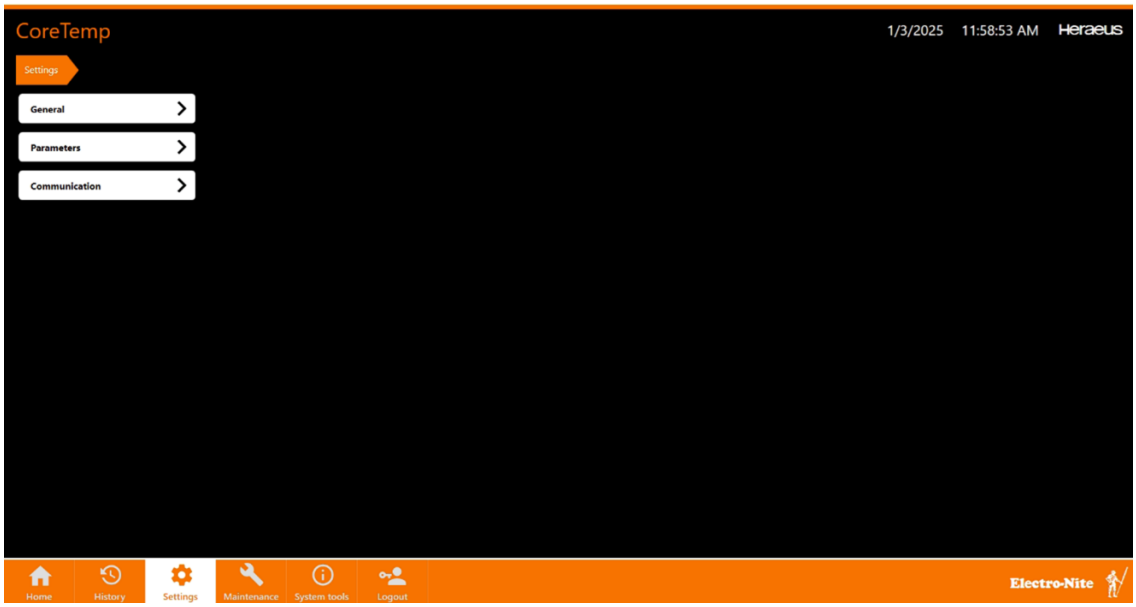


On the ‘Export data’ page the user can select which items they would like to export.

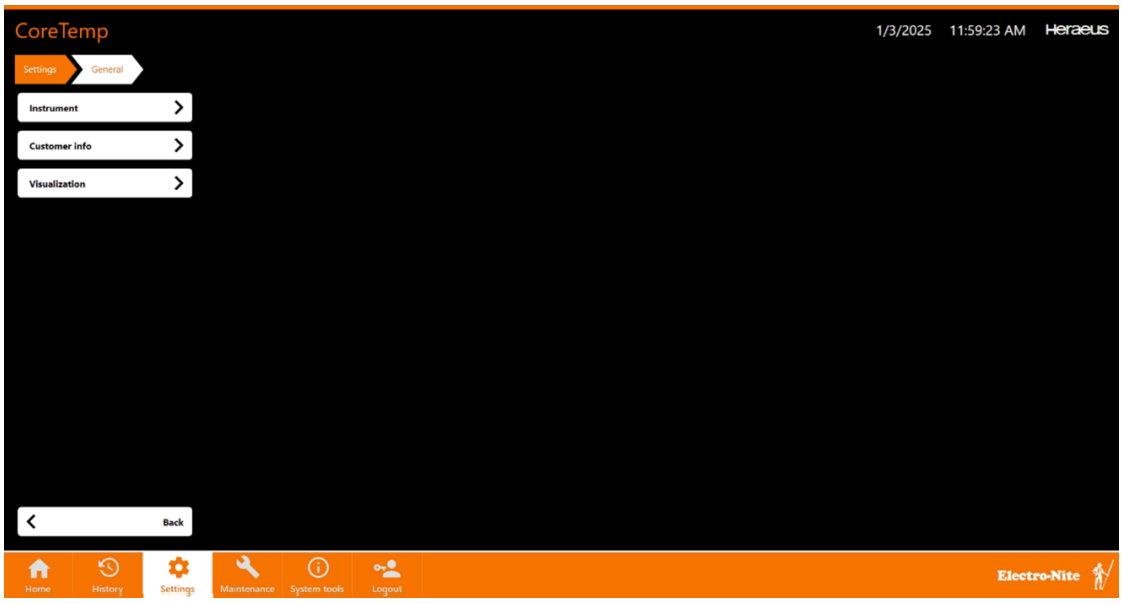


9 Settings

To access the settings screen, you need to login with the supervisor password (see 7.2).



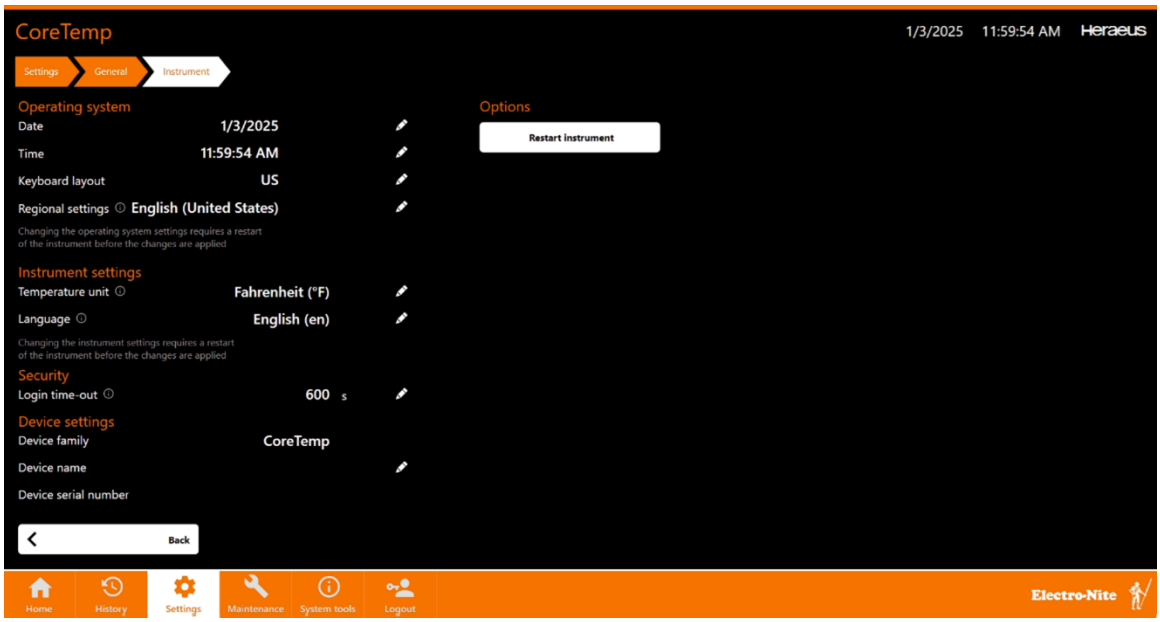
9.1 General Settings



Settings menu	Description	Paragraph
Instrument	Instrument specific settings: date, time, unit, language, filter lifetime, preparation screen timeout	9.1.1
Customer info	Enter customer specific information to show on the screen header	9.1.2
Visualization	Graph and result precision settings	9.1.3

9.1.1 Instrument

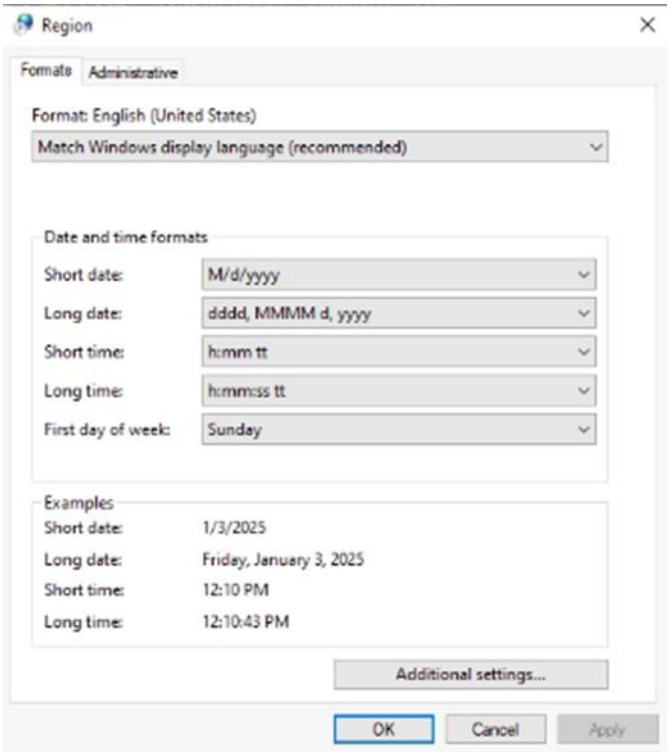
In this screen as shown below, you can change date, time and regional settings of the instrument that will be shown in the measurement graph. Changing these settings requires a restart of the instrument before changes are applied.



Click the pencil to change the default settings.

Parameter	Description (options)	Default value
Date	Date used for the instrument	
Time	Time used for the instrument	
Keyboard layout	Here you can go to the systems language settings and change the keyboard-layout	
Regional settings	Instead of editing the regional settings directly, the user is redirected to the standard regional settings dialog box of the operating system	English (United States)
Temperature unit	This setting is used to set the instruments temperature setting, and all displayed temperatures on the instrument are displayed in the selected unit (°C or °F)	°C
Language	This is the systems language setting, all labels, buttons, messages are displayed in the selected language (English (en), French (fr), German (de), Chinese (zh), Korean (ko), Japanese (ja))	English
Login time-out	This parameter is used to logout automatically when the set time is exceeded (60 – 600 s)	120 s
Restart instrument	When you click this button, the instrument will restart	

When you click the **Regional settings** button, instead of editing the regional settings directly, the user is redirected to the standard regional settings dialog box of the operating system:



9.1.2 Customer Info

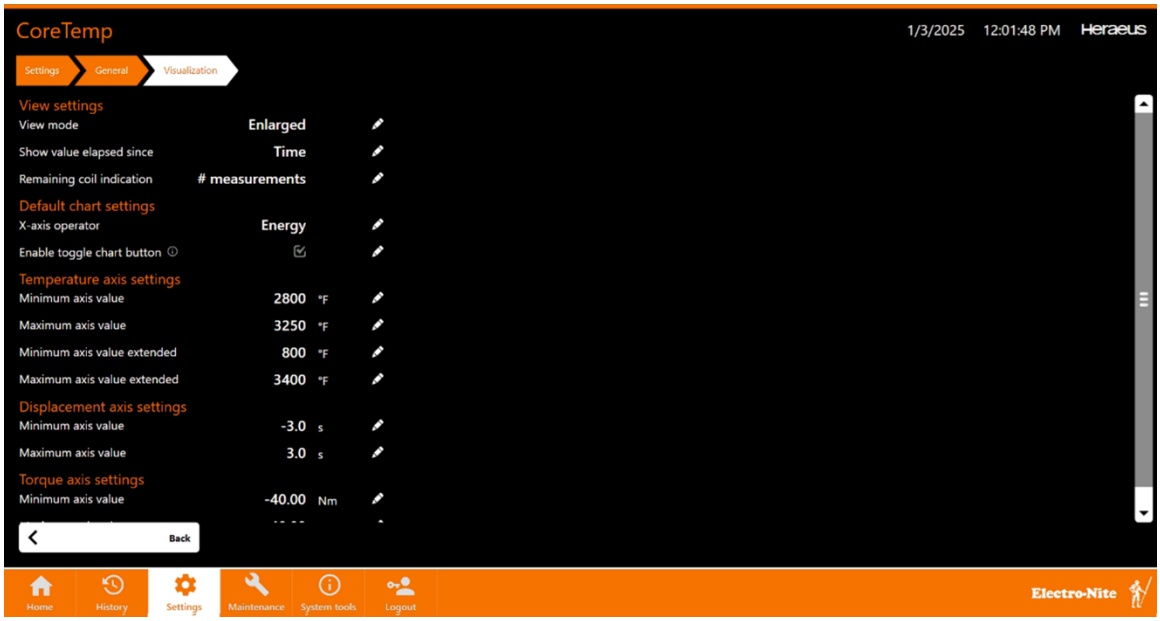
In this screen you can change customer, city and location data that will be shown in the measurement graph.

Click the pencil to change the default settings.

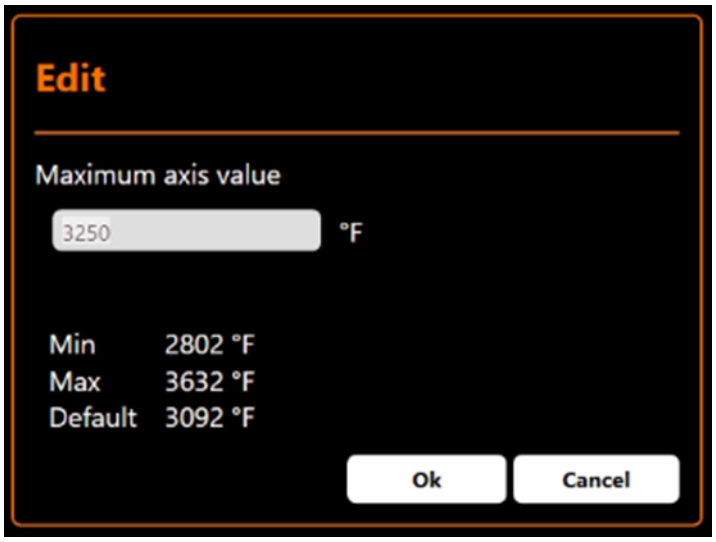
Setting	Description
Customer	Name of the customer – shown in the heading of the screen, used for export and remote connection.
City	Name of the city – shown in the heading of the screen, used for export and remote connection.
Location	Name of the location – shown in the heading of the screen, used for export and remote connection

9.1.3 Visualization

In this screen you can change values for axes settings that will be shown in the measurement graph.



When a parameter is selected for editing, a window appears for setting the parameter together with default, minimum and maximum setting.

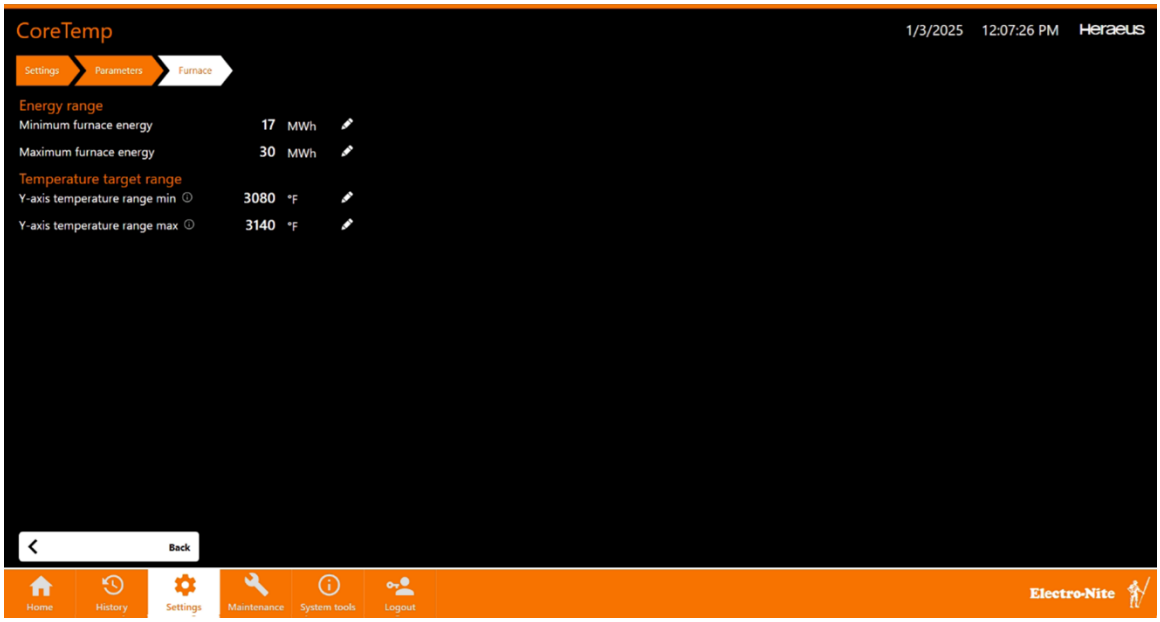


Parameter	Description	Default value
View mode	An enlarged view is available	Normal
X-axis operator	Choice between Energy or Time	Energy
Temperature axis settings		
Minimum axis value	Min value of the temperature axis between 0 – 1699°C	1500 °C
Maximum axis value	Max value of the temperature axis between 1501 – 2000°C	1700 °C
Minimum axis value extended	Extended view, min value between 0 – 1799°C	1000 °C
Maximum axis value extended	Extended view max value between 1001 – 2000°C	1800 °C
Displacement axis settings		
Minimum axis value		-3 s
Maximum axis value		3 s
Torque axis settings		
Minimum axis value		-40 Nm
Maximum axis value		40 Nm

9.2 Parameters

Parameter	Description	Default value	User level
Furnace	Furnace type can be set (EAF, ConSteel, LMF), End of heat detection (use tilt) Energy range Guide tube length	EAF 10° 50 – 75 MWh 13 m	Supervisor
Trace Analysis	Cold detection Scrap detection		System engineer
Heat evolution	Algorithm parameters Profiles		System engineer
Multi-Dip	Multi-Dip parameters Profiles		System engineer
Coil	Notification settings for the coil length		Supervisor
PLC			System engineer

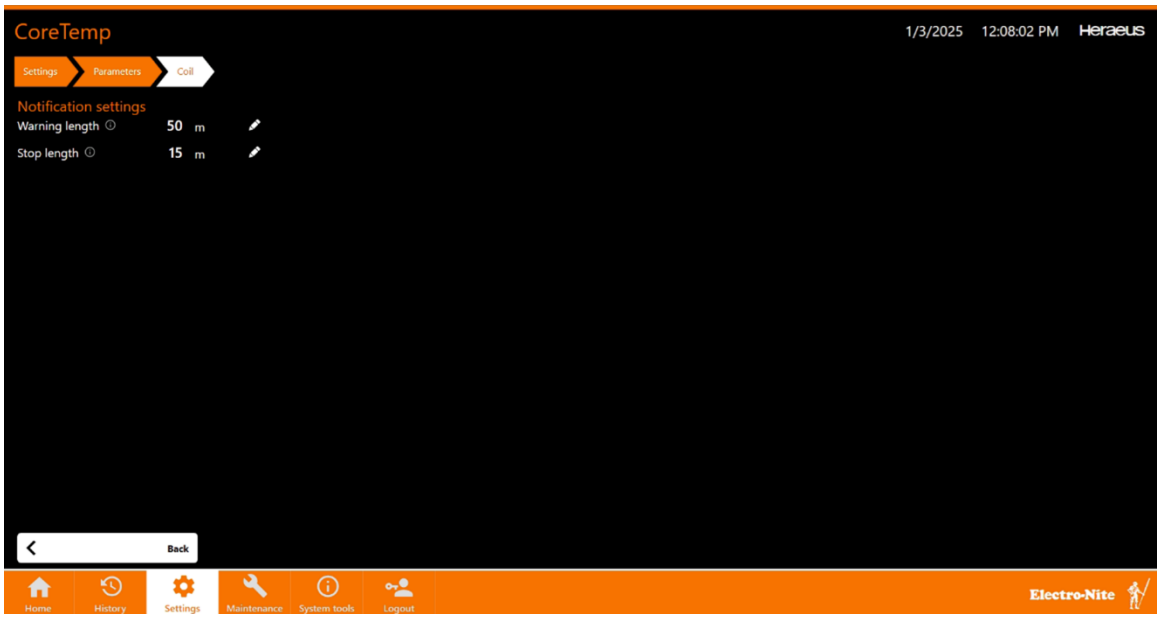
Note: Parameters with user level system engineer can only be changed by Heraeus Electro-Nite qualified personnel. Changing these parameters might result in system instability and unwanted behavior.



Note: The options shown on the furnace tab depend on the type of furnace selected.

Click the pencil to change the default settings.

Parameter	Description	Default value
Minimum furnace power	Sets the minimum furnace power for taking single measurements.	50 MWh
Maximum furnace power	Sets the maximum furnace power for taking single measurements.	75 MWh
Y-axis temperature range min		1600 °C
Y-axis temperature range max		1620 °C



Click the pencil to change the default settings.

Parameter	Description	Default value
Warning length	Set length when the notification “almost out of coil” appears (10 – 1000m)	50 m
Stop length	Set length when the notification “coil is empty” appears (10 – 100m)	25 m

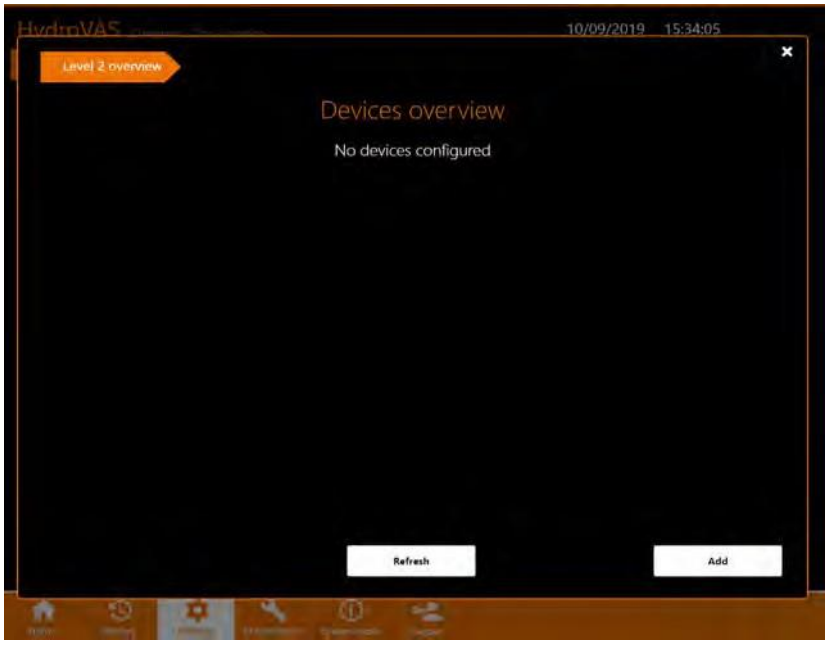
10 Level2 Communication

The Level2 communication is used to configure data telegrams and their destinations. That is what the data telegrams contain and where they will be sent.

10.1 Configure Level2 Communication

To configure level2 communication on the CoreTemp system perform the next steps:

1. Login and go to ***Settings*** > ***Communication*** > ***Configuration***.



This screen gives an overview of the Level2 devices installed. At start up this screen is empty. You can start to add devices.

2. Click **Add**.

You get a list of devices. The devices marked in white and bold are active and can be selected.

3. Select which device you would like to add with the radio button. Click **Add**.

You get an overview of the device settings. By clicking the dropdown menu, you can adapt these setting.

4. Click **Next**.

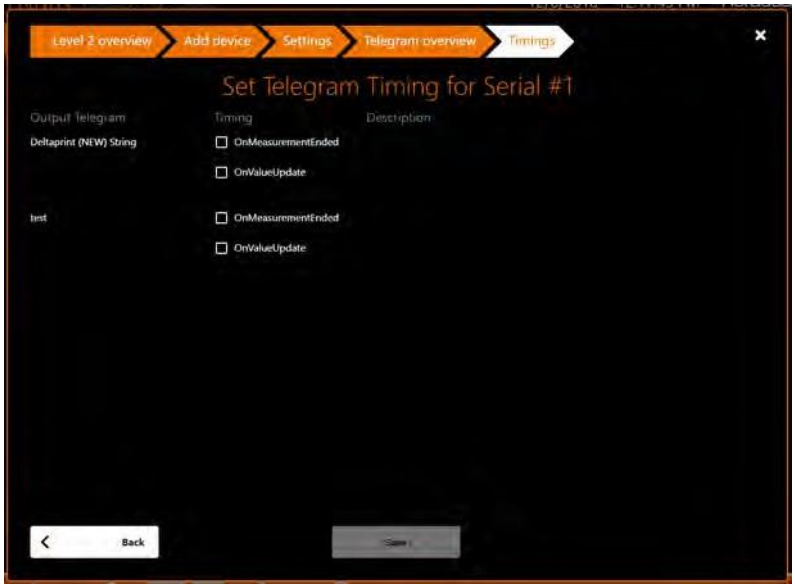
You get an overview of telegrams that can be assigned to this device.

5. Click the eye icon to view the input or output telegrams.

	**Note:** The input telegrams are preset and cannot be changed, only viewed. A set of frequently used output telegrams is also already defined. These can be viewed, copied, changed and exported. Default telegrams cannot be deleted.

6. To change the preset output telegrams:

   a. Click the **Copy** button.
   b. Make changes in the copy.
   c. Test the copy.
   d. Enter a Name and Save this as a new telegram.
   e. Click the pencil to make changes afterwards.
7. To export the entire telegram on the screen to a file, click the **Export** button.
8. Telegrams to be used can be selected on the Telegram Overview screen, by clicking the boxes in front of the Telegram name. Click **Next**



On this screen you can select the timing when the telegram is sent.

9. Select the timing by clicking the box in front. Click **Save**.

10.2 Device Settings

10.2.1 Serial

Table 19: Serial device settings

Name	Options (default)	Description
Port	COMX	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Baud rate	300 – 600 – 1200 – 2400 – 4800 – 9600 – 19200 – 38400 – 57600 115200	Speed of the serial communication
Parity	None/Even/Odd/Mark/Space	Parity used for the serial communication
Databits	8 or 7	Number of data bits used for the serial communication
Stopbits	One/Two/OneAndAHalf	Number of stop bits used for the serial communication
Protocol	None/Siemens3964/Siemens3964R/ Siemens3964_RK512/ Siemens3964R_RK512/StxEtx	Protocol used for the serial communication
Mode	TTY/RS232	Measurement mode for the serial communication, depending on the hardware
Rx loop mode	Passive/Active	Only for TTY – mode for the receiving side
Tx loop mode	Passive/Active	Passive/Active

10.2.2 TCP Client Settings

Name	Options (default)	Function
Port	1024	Port opened at the server side that the CoreTemp software connects to
IP address	192.168.1.1	IP address of the server where the client needs to connect to

10.2.3 TCP Server Settings

Name	Options (default)	Function
Port	1024	Port opened on the CoreTemp software where the customer TCP client will connect to

10.2.4 Ethernet/IP Settings

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
IP address	192.168.1.1	IP address of the server where the client needs to connect to
Subnet mask	255.255.255.0	
Assembly instance input	150	
Assembly instance output	100	
Input Register Size (bytes)	64	
Output Register Size (bytes)	244	

10.2.5 Modbus RTU Settings

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Baud rate	1200 – 2400 – 4800 – 9600 – 19200 – 38400	Speed of the serial communication
Parity	NoneWithOneStopBitNoneWithTwoStop-Bits OddParityWithOneStopBit EvenParityWithOneStopBit	Parity used for the serial communication
Slave ID	20	
Input Register Size (bytes)	0	
Output Register Size (bytes)	128	

10.2.6 Modbus TCP Settings

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
IP address	192.168.1.1	IP address of the server where the client needs to connect to
Subnet mask	255.255.255.0	
Input Register Size (bytes)	64	
Output Register Size (bytes)	244	

10.2.7 Profibus Settings

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Device address	24	Node ID for the Profibus connection
Number of data units	7 * 16 – Output – Word 1 * 10 – Output – Word 4 * 8 – Input – Word	
Direction	Output/Input/InputOutput	
Type	Word/Byte	

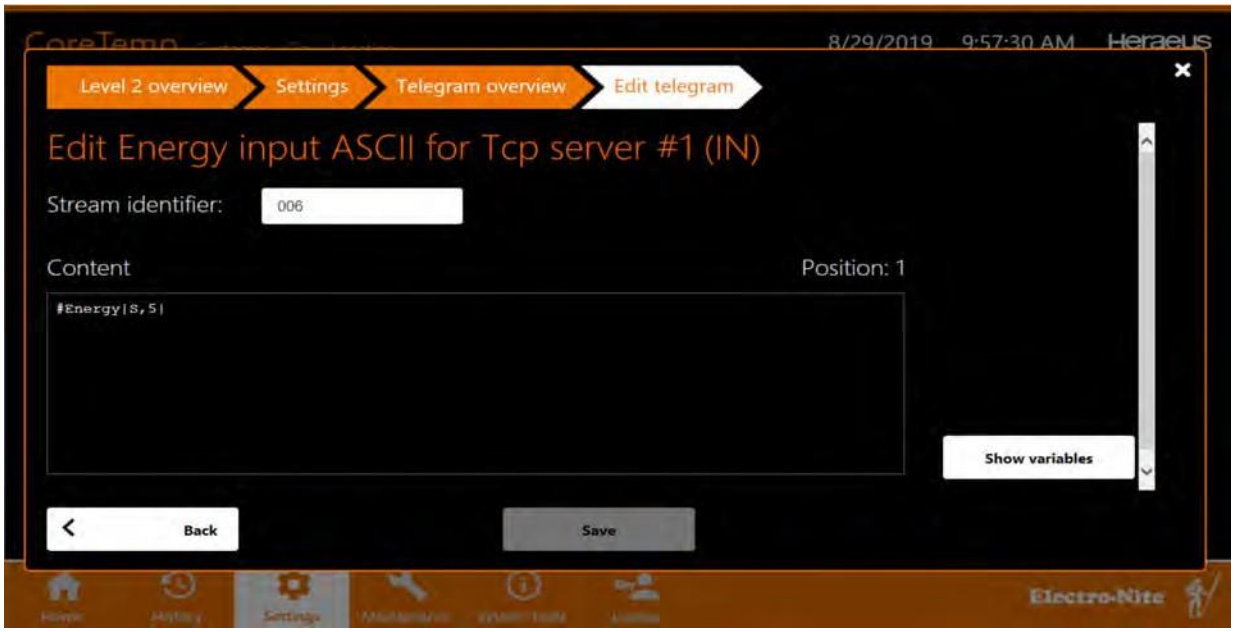
10.2.8 Profinet Settings

Name	Options (default)	Function
Port	COMX (in use by current device)	Internal port where the option is physically connected to. This port will be auto-detected by the software.
Modules	8 * 16 – Output – Word 4 * 8 – Input – Word	
Download GSDML		

10.3 Default Telegrams

10.3.1 Serial/TCP Protocols

The stream identifier is the unique identification for an input telegram. The first part of the telegram should contain the stream identifier for the instrument to recognize which input telegram is sent. The stream identifier is always ASCII. Make sure that it is unique and that the stream identifier does not contain the first part of another one.



For example, Celox temperature has identifier 008.

```
Format: #var |S,6|
Content #CeloxTemperature|S,6|
Example: 0081624.5
Output: Celox Temperature: 1624.5
```

10.3.2 Overview of the identifiers and the syntax of the input variables

Input register	Stream identifier	Example		Syntax variable
Heat number	002	002Heat0123	Ascii fixed 8	#Heat|S,8|
Energy input	003		Floating point	#Energy|F, H|
Tilt input	004		Floating point	#Tilt|F, H|
Celox temperature input	005		Floating point	#CeloxTemperature|F, H|
Energy input ASCII	006	00655,42	Ascii fixed 5	#Energy|S,5|
Tilt input ASCII	007	007-3,21	Ascii fixed 5	#Tilt|S,5|
Celox temperature input ASCII	008	0081624,5	Ascii fixed 6	#CeloxTemperature|S,6|

10.3.3 Industrial Protocols

10.3.3.1 Input

Choose between high byte or low byte first and then proceed.

10.3.3.2 Input telegrams for Profibus, Profinet, Ethernet IP and Modbus TCP

Offset bytes	Variable name	Type
0	L2StatusByte	BitArray
4	Heat Number	Ascii fixed 8
12	Energy	Single Precision Floating Point
16	Tilt	Single Precision Floating Point
20	CeloxTemperature	Single Precision Floating Point
24	Celox mV	Single Precision Floating Point
28	Celox aO	Single Precision Floating Point
32	BathLevel	Single Precision Floating Point
36	Target Tap Temperature	Single Precision Floating Point
40	Weight	Single Precision Floating Point
44	Ladle Temperature	Single Precision Floating Point
48	Ladle Heat Number	Ascii fixed 8
56	Level Offset	Single Precision Floating Point

10.3.3.3 Bit array L2 status bytes

Byte	Bit	Content	Info
0	7	Start hot heel measurement	Set high for 1s to start heel measurement
	6	Start tap measurement	Set high for 1s to start tap measurement
	5	Start sequence measurement	Set high for 1s to start sequence measurement
	4	Start single measurement	Set high for 1s to start single measurement
	3	Start homing	Process to zero set cored wire length
	2	System ready (customer side)	Set high when sliding gate is opened and when guiding tube is in place.
	1	Abort active process	Cored wire will be retracted and will go to idle state
	0	Reset system	Reset for hardware error
1	5	Activate cutting	Toggle high for 1s to Activate / Deactivate Cutting Process
	0	Start bath level measurement	Set high for 1s to start heel measurement

Unlisted Bits of Bytes 1, 2, and 3 are Spare.

10.3.3.4 Output

Choose between high byte or low byte first and then proceed.

10.3.3.5 Industrial output telegram for Profibus, Profinet, Ethernet IP and Modbus TCP

Address	Variable Name	Type	Description
0	StatusByte	BitArray	System status information
2	MeasurementError	BitArray	Measurement status information
4	SystemError	BitArray	Detailed information when a system error is active
6	StatusByteBlock2	BitArray	Additional system status information
8	Heat	Ascii fixed 8	Heat Number
16	Total_Used_Length	Single Precision Floating Point	Total Length Used in Current Heat (meters)
20	T_0	Single Precision Floating Point	*Place Holder Future Data*
24	T_0	Single Precision Floating Point	*Place Holder Future Data*
28	T_0	Single Precision Floating Point	*Place Holder Future Data*
32	T_Estimated	Single Precision Floating Point	Estimated Temperature
36	L_Estimated	Single Precision Floating Point	Estimated Level
40	L_Slope	Single Precision Floating Point	Level Slope
44	Temperature01	Single Precision Floating Point	Latest Measurement Temperature Result
48	Power01	Single Precision Floating Point	Power at Latest Measurement
52	Level01	Single Precision Floating Point	Latest Measurement Bath Level Result
56	Weight01	Single Precision Floating Point	Weight at Latest Measurement
60	MeasurementQuality01	INT	Latest Measurement Temperature Result Quality
62	MeasurementType01	Ascii fixed 6	Latest Measurement Type
68	UsedLength01	Single Precision Floating Point	Latest Measurement Used Wire Length (meters)
72	RemainingCoilLength01	Single Precision Floating Point	Latest Measurement Remaining Coil Wire Length (meters)
76	Temperature02	Single Precision Floating Point	
80	Power02	Single Precision Floating Point	
84	Level02	Single Precision Floating Point	
88	Weight02	Single Precision Floating Point	
92	MeasurementQuality02	INT	
94	MeasurementType02	Ascii fixed 6	
100	UsedLength02	Single Precision Floating Point	
104	RemainingCoilLength02	Single Precision Floating Point	
108	Temperature03	Single Precision Floating Point	
112	Power03	Single Precision Floating Point	
116	Level03	Single Precision Floating Point	
120	Weight03	Single Precision Floating Point	
124	MeasurementQuality03	INT	
126	MeasurementType03	Ascii fixed 6	
132	UsedLength03	Single Precision Floating Point	
136	RemainingCoilLength03	Single Precision Floating Point	
140	Temperature04	Single Precision Floating Point	
144	Power04	Single Precision Floating Point	
148	Level04	Single Precision Floating Point	
152	Weight04	Single Precision Floating Point	
156	MeasurementQuality04	INT	
158	MeasurementType04	Ascii fixed 6	
164	UsedLength04	Single Precision Floating Point	
168	RemainingCoilLength04	Single Precision Floating Point	
172	Temperature05	Single Precision Floating Point	
176	Power05	Single Precision Floating Point	
180	Level05	Single Precision Floating Point	
184	Weight05	Single Precision Floating Point	
188	MeasurementQuality05	INT	
190	MeasurementType05	Ascii fixed 6	
196	UsedLength05	Single Precision Floating Point	
200	RemainingCoilLength05	Single Precision Floating Point	
204	Temperature06	Single Precision Floating Point	
208	Power06	Single Precision Floating Point	
212	Level06	Single Precision Floating Point	
216	Weight06	Single Precision Floating Point	
220	MeasurementQuality06	INT	
222	MeasurementType06	Ascii fixed 6	
228	UsedLength06	Single Precision Floating Point	
232	RemainingCoilLength06	Single Precision Floating Point	

10.3.3.6 Bit array status byte output

Byte	Bit	Content	Info
0	7	Process complete	Set high when for 1s when new heat number is received, clear data when put to low.
	6	System lock (for safety)	Set high during measurement, manual mode, or emergency stop
	5	End Sequence Measurement	Set high for 1s when result is sent out.
	4	End Single Measurement	Set high for 1s when result is sent out.
	3	Error	Set high for emergency stop or hardware error, check Error bytes for more information
	2	Green (ready to measure)	Set high when system is ready to measure
	1	Yellow (process busy)	Set high during measurement cycle
	0	Red (measurement end)	Set high when measurement is complete and cored wire is retracted to its default position
1	7	Heartbeat	
	6	Ready Hot Heel	Set high when system is ready to measure Hot Heel Level
	5	Cutting Active	Set high when measurement process will include cored wire cutting process (*will be made obsolete, please refer to Byte 7 – Bit 0*)
	4	Bath Level Ready	Set high when system is ready to measure Bath Level
	3	End Bath Level	
	2	End Tapping	
	1	End Hot Heel	
	0	Homing	
2	7	Almost out of coil	
	6	Measurement time	
	5	Freeboard not found	
	4	Blowing Lance Blocked	
	3	Major Scrap	
	2	Minor Scrap	
	1	No Evaluation	
	0	Cold Measurement	
3	7 - 1	Spare	
	0	Aborted	
4	7	Homing error	
	6	Hardware error	
	5	Safety error	
	4	Coil error	
	3	Motor drive error	
	2	Emergency stop	
	1	PLC error	
	0	CoreTemp system error	
5	7 -3	Spare	
	2	Air Flow Error	
	1	Air Pressure Error	
	0	Cutting Error	
6	7 - 0	Spare	
7	7 - 3	Spare	
	2	Advance Cutter	Set high when cutter blade is signaled to extend
	1	Retract Cutter	Set high when cutter blade is signaled to retract
	0	Cutting Active	Set high when measurement process will include cored wire cutting process

Manual Mode: Byte 0, Bit 6
Emergency Stop: Byte 0, Bit 6 + Byte 0, Bit 3
Measurement: Byte 0, Bit 6 + Byte 0, Bit 1
Complete: Byte 0, Bit 0 + End Measurement Type Bit

10.4 Telegram Construction

In general, there are three types of output: free text, control characters and variables.

10.4.1 Free Text

Free text is allowed in telegram definitions. Just type the text you want to output. There is however one exception. The character # is not allowed in free text because it is used to distinguish placeholders from free text. If you want this character in the output, use the control character placeholder (see next paragraph).

In industrial telegrams you can insert empty spaces with no functionality just to register reservations.
Syntax: #*X with X is the number of bytes you wish to insert.

10.4.2 Control Characters

The control character placeholder is used to output a specified ASCII character. The purpose is to output characters that are not typeable (ex. STX, ETX, LF...), but it is also possible to output typeable character such as 1, 2, 3, or A, B, C.

```
Format: #$XX
Example: #$0DDATE:
```

The *xx* should be replaced with the hexadecimal code from the character you would like to output. The hexadecimal value can be found in an ASCII table.

10.4.3 Variables

They all have the same base syntax:

```
#var |x|
```

The var should be replaced with the stream identifier of the variable you want to output. The x will define how you output the selected variable:

- #var |B|: the variable must be output as an unsigned byte. If not applicable or error output: 0x00
- #var |I,x,y,z|, where y tells you to multiply or divide by z and z is the value of the multiplier or divider.

Example:

```
Temperature|I,H,*,3| means that if the value is 0.235, than the output to level 2 will be
0.235*10^3=235.
```

- #var |D,x|, #var |F,x|: the variable will be output as a signed 2 byte integer resp. 4 byte integer or 4 byte floating point.
  The x indicates the byte order: H = high byte first and L = low byte first.
  If not applicable or error output: 0x00 00 resp 0x00 00 00 00 resp 0xFF FF FF FF
- #var |C,u,v,w,x|: the variable will be output as a character with fixed decimal separator.

u	the number of digits before the decimal separator (including the sign character if present)
v	the number of digits after the decimal separator
w	sign character
x	prefix

- #var |C, F, y, z, w, x|: the variable will be output as a character with floating decimal separator

y	the total amount of digits (including the sign character if present)
z	the maximum number of digits after the decimal separator
w	sign character
x	prefix

The error character is fixed “F” and the not applicable character “0”.

- #var |S, x, y, z|: the variable will be output as a string.

x	total length of the output text
y	alignment parameter (L = left, R = right)
z	filling character (hexadecimal ASCII code)

If not applicable the filling character is shown x times.

- #var |T, x…x|: the variable will be formatted as a Date/Time and output as an ASCII byte series.

Example:

```
#$0DDATE: #DATE|T, DD-MM-YY|
output: DATE: 18-12-18
```

- #var |T, UNIX, x|: the variable will be formatted as a Date/Time and output as a byte series that represent a couple of numerical values.

The x indicates the byte order: H = high byte first and L = low byte first.

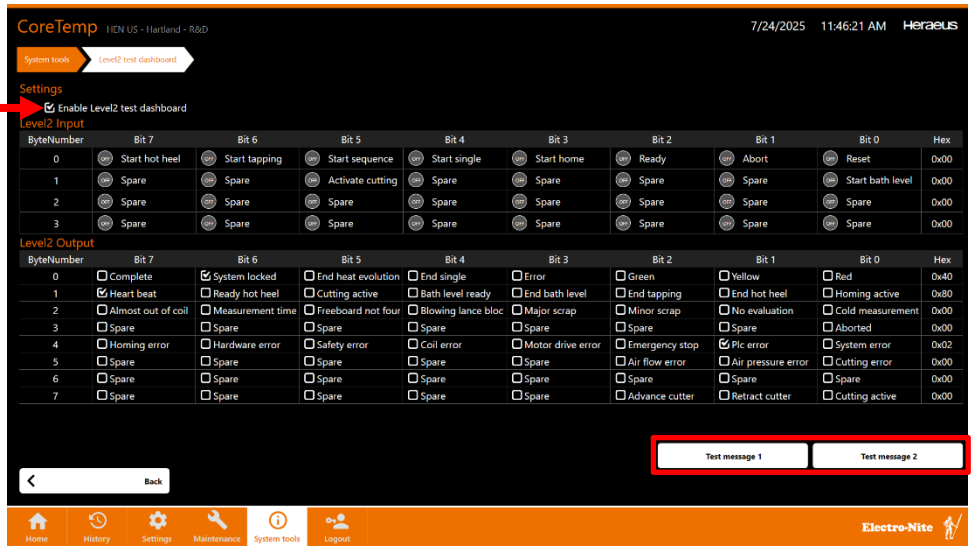
10.4.3.1 Available variables

Variable Name	Description
Heat	Heat Number
Total_Used_Length	Total Length Used in Current Heat (meters)
Temperature[]	Array of Temperature Results from Current Heat
Energy[]	Energy at Each Measurement
Level[]	Array of Bath Level Results from Current Heat
Weight[]	Weight at Each Measurement
MeasurementQuality[]	Quality of Each Temperature Result
MeasurementType[]	Type of Each Measurement
UsedLength[]	Used Wire Length (meters) of Each Measurement
RemainingCoilLength[]	Remaining Coil Wire Length (meters) After Each Measurement
HotHeel_Height	
HotHeel_Power	
HotHeel_Temperature	

10.5 Test Telegrams

The telegram can be filled with test data by Enabling Level 2 test dashboard in System tools.

- Telegram content can be changed by pressing the Test message buttons



Offset	Variable Name	Type	Description	Test Value 1	Test Value 2
1	StatusByte	BitArray	System status information	11110000	01010101
2	MeasurementError	BitArray	Measurement status information	_0001111	_1010101
4	SystemError	BitArray	Detailed information when a system error is active	11110000	01010101
8	Heat	Ascii fixed 8	Heat Number	a1234567	8765432a
16	Total_Used_Length	Single Precision Floating Point	Total Length Used in Current Heat (meters)	1	2
20	T_0	Single Precision Floating Point	*Place Holder Future Data*	*0*	*0*
24	T_0	Single Precision Floating Point	*Place Holder Future Data*	*0*	*0*
28	T_0	Single Precision Floating Point	*Place Holder Future Data*	*0*	*0*
32	T_Estimated	Single Precision Floating Point	Estimated Temperature	2950	3050
36	L_Estimated	Single Precision Floating Point	Estimated Level	11	22
40	L_Slope	Single Precision Floating Point	Level Slope	1	1
44	Temperature01	Single Precision Floating Point	Latest Measurement Temperature Result	2950	3050
48	Energy01	Single Precision Floating Point	Energy at Latest Measurement	56	60
52	Level01	Single Precision Floating Point	Latest Measurement Bath Level Result	21	34
56	Weight01	Single Precision Floating Point	Weight at Latest Measurement	543	654
60	MeasurementQuality01	INT	Latest Measurement Temperature Result Quality	00000001	00000010
62	MeasurementType01	Ascii fixed 6	Latest Measurement Type	SINGLE	BATHLV
68	UsedLength01	Single Precision Floating Point	Latest Measurement Used Wire Length (meters)	1.9	2.3
72	RemainingCoilLength01	Single Precision Floating Point	Latest Measurement Remaining Coil Wire Length (meters)	678	589

11 Maintenance

11.1 Maintenance Scheme

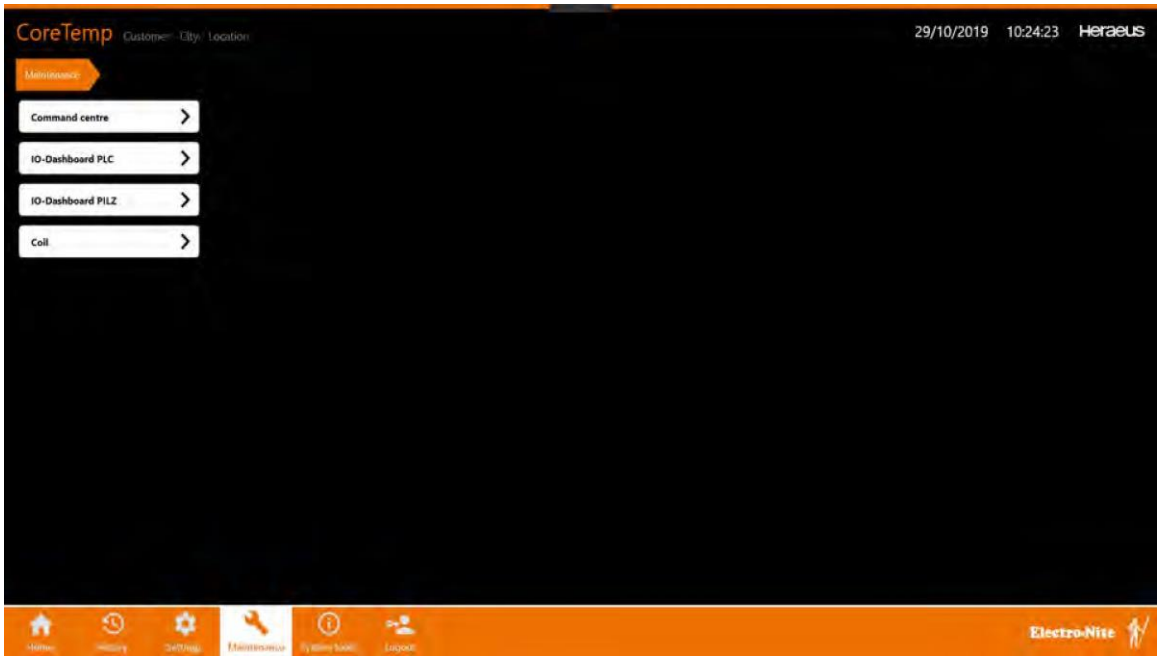
For the following maintenance instructions normal use is considered. With heavy use, or use under extreme conditions, maintenance should be performed at shorter intervals.

Frequency	Who	Type	Details in paragraph
Weekly	Operator	Check the CoreTemp measurement system. The system is subject to thermal and mechanical stress.	
	Operator	Check connection cables, replace when broken	
	Operator	Test the safety circuit	
	Operator	Check readability of safety pictograms on the equipment, replace when necessary	
	Operator	Check blowing lance for blockages	11.4
	Operator	Replace cored wire coil. Replace as soon as warning message pops-up.	11.3
Monthly	Operator	Replace blowing lance	11.5
Yearly	HEN service engineer	Check the in- and outlet of the cored wire feeder if it is damaged or worn out	
	HEN service engineer	Inspection of the feeder (V-wheels, springs, encoder arm)	
	Operator/HEN service engineer	Replace all the guide tubes	
	Operator	Check the electric installation for damage	

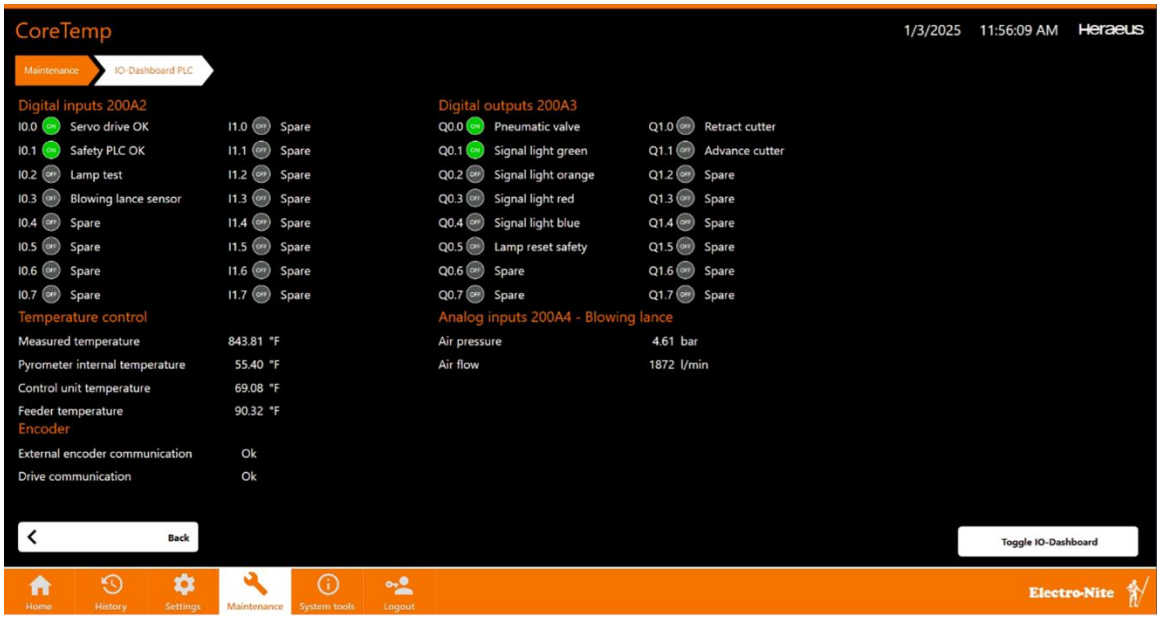
Warning: Maintenance or repair works on the feeder are only to be performed by Heraeus Electro-Nite personnel.

11.2 Maintenance Screen

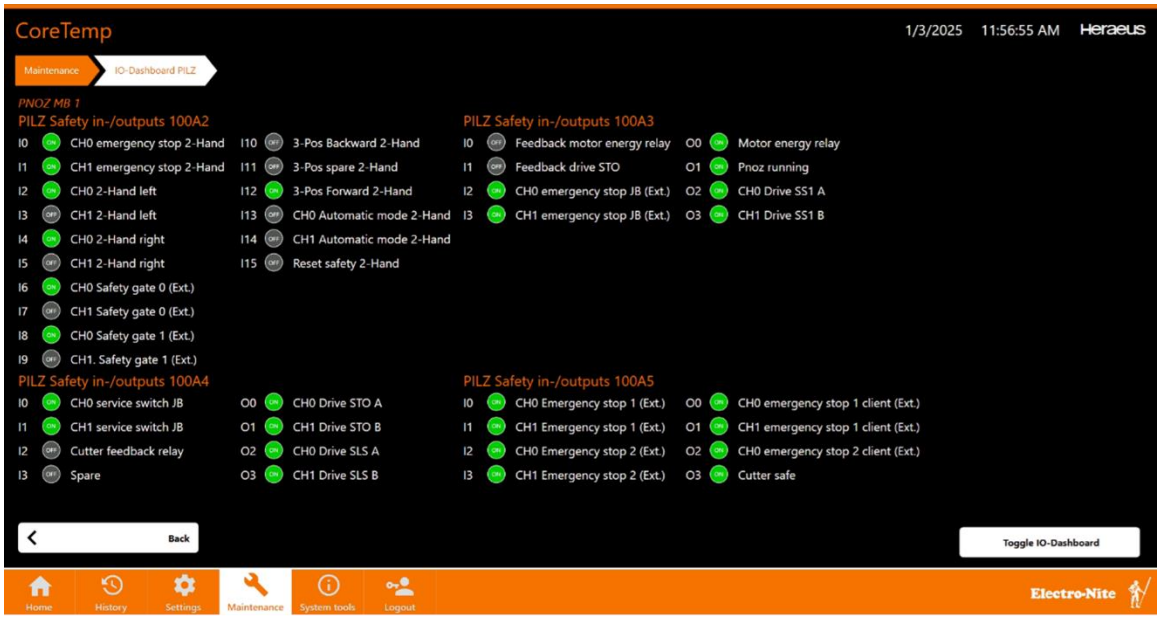
The maintenance screen gives access to the **Command center** as described in section 0 and to information on the **IO-Dashboards** and the **Coil**.



On IO-Dashboard PLC -page the user gets an overview of important in and outputs from the PLC.

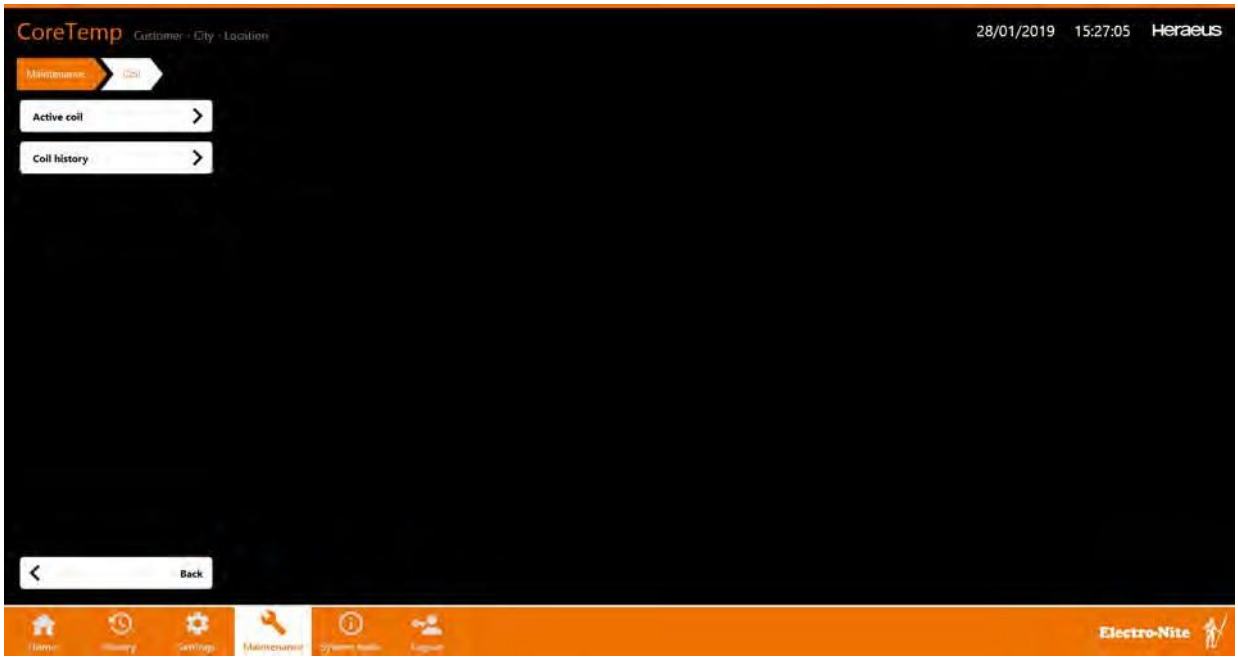


On IO-Dashboard PILZ -page the user gets an overview of important in and outputs from the PILZ.

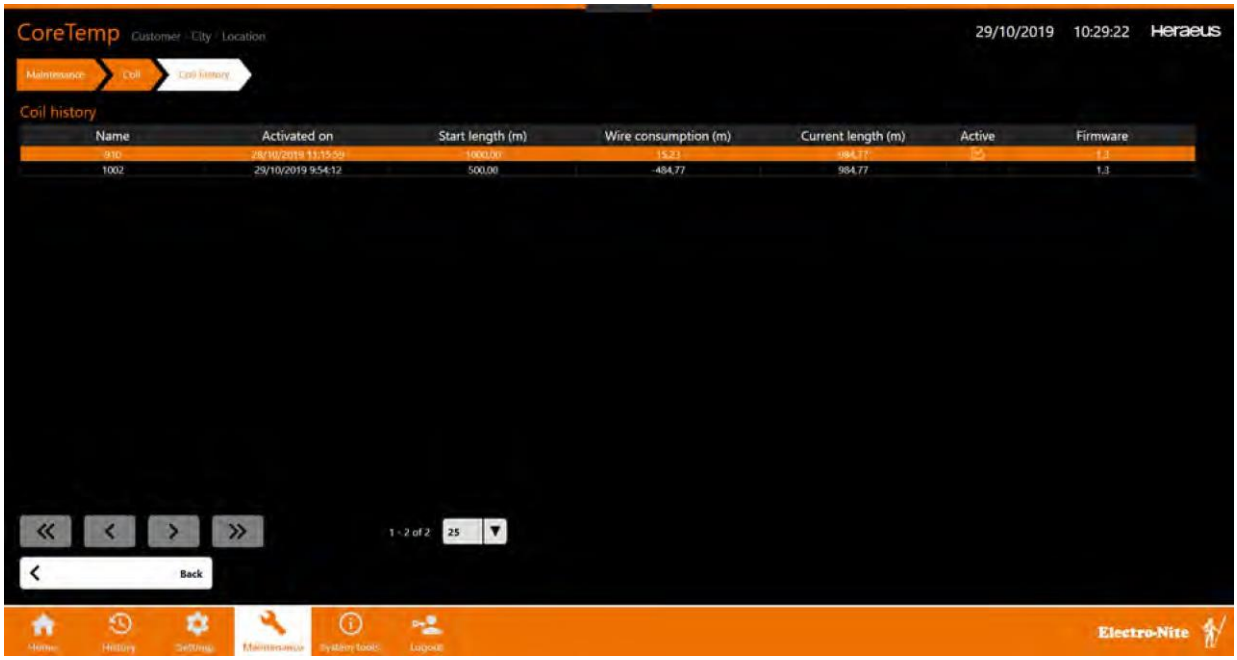


	**Note:** There are different dashboards for the PILZ, depending on the Safety PLC/PNOZ.

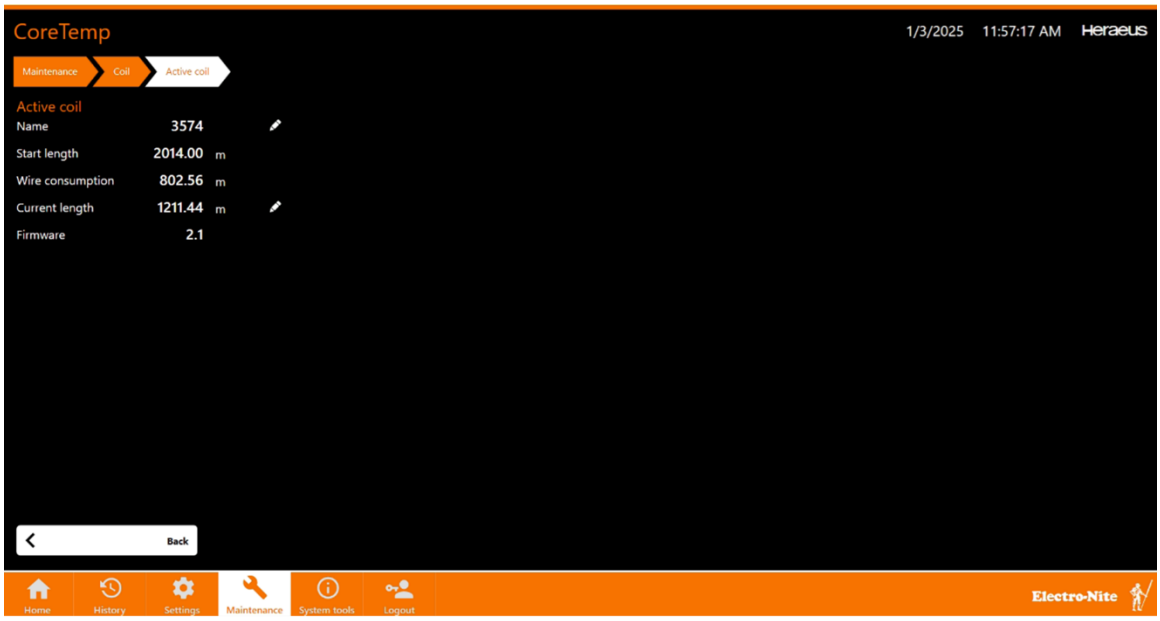
The Maintenance > Coil page is an in-between/sub-page, to navigate further to other menus or pages.



On the **Coil history** page, the user can view all information about the coils used on the system, and which one is active.



After login the supervisor also has access to all information about the Active coil and in this page he can change/update the name of the coil and the current length.



Click the pencil to change the default settings.

11.3 Replacing Cored Wire Coil

11.3.1 Introduction

The Cored Wire is consumed during CoreTemp measurements. Coils must be exchanged periodically during the normal operation of the system.

Before you begin:

Personnel:

Number of workers: 2
Skill level: Furnace crew
Time estimate: 10 min

Equipment:

- Material handling equipment for new coil and removing empty package
- Tool to cut cored wire

Material:

- New CoreTemp Coil

Safety:

⚠	**Warning:** • Follow site-specific Lock Out procedure • Proper Personal Protective Equipment should be used for all process steps • Operators should not contact the CoreTemp Coil or Equipment during furnace arcing.

!	**Important Note:** • Always fully retract the cored wire from previous coil from the feeder before inserting the cored wire from the new coil into the feeder. • Attempting to join the two pieces of wire can result in mechanical jams that can be very difficult to resolve – resulting in significant downtime for the CoreTemp System.

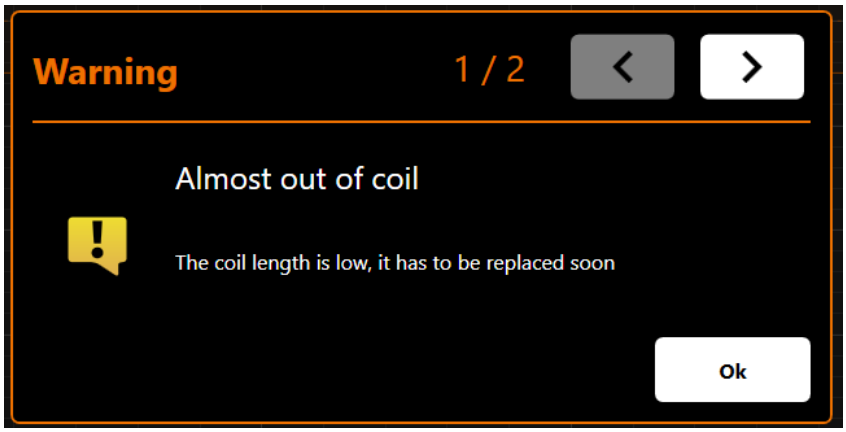
11.3.2 Instructions

11.3.2.1 When to Replace the Coil

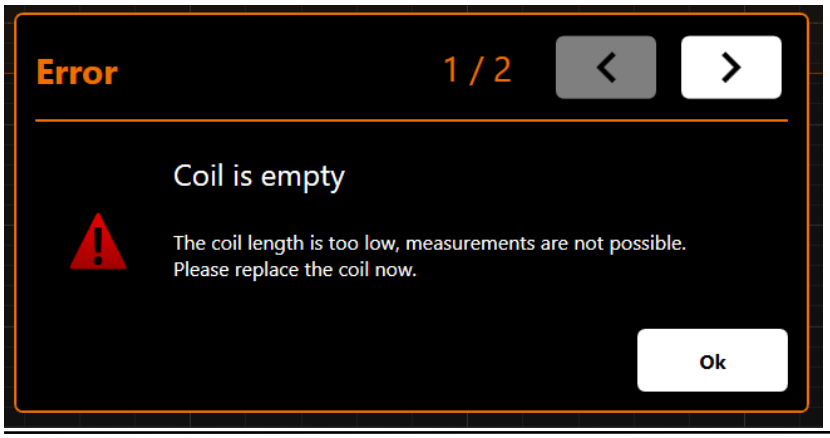
The coil status bar on the operator screen shows the remaining length of the cored wire. When the coil length status bar drops down into the Yellow section of status bar, the low length warning is displayed. The CoreTemp system operates normally until the length of the cored wire length drops into the Red section of status bar. Once the remaining coil length enters the Red section, a safety stop is activated and it is no longer possible to take measurements.

The Sensor Length Bar indicates the length of cored wire remaining on the coil.

- Yellow: Warning – Low Length of remaining cored wire.
  - A warning message will be displayed indicating that the coil needs to be replaced.
  -



- Red: End of Cored Wire Coil – CoreTemp will not measure until the coil is replaced.
  - An error message will be displayed indicating that the coil is empty.
  - It will not be possible to take measurements until the coil is replaced.



11.3.3 Disconnect the Empty CoreTemp Coil

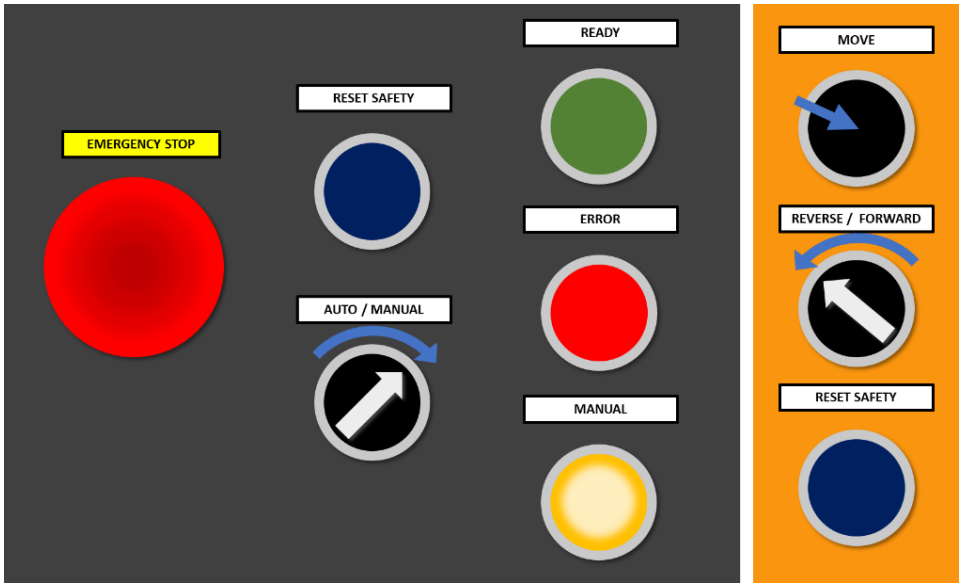
11.3.3.1 Place the System in Local Control

- Place the Local Control in MANUAL mode.
  - Feeder movement can now only be initiated from the Local Control.

Warning:
- Always place the system into Manual mode on the Local Control before touching the cored wire – to avoid unexpected movement of the cored wire.

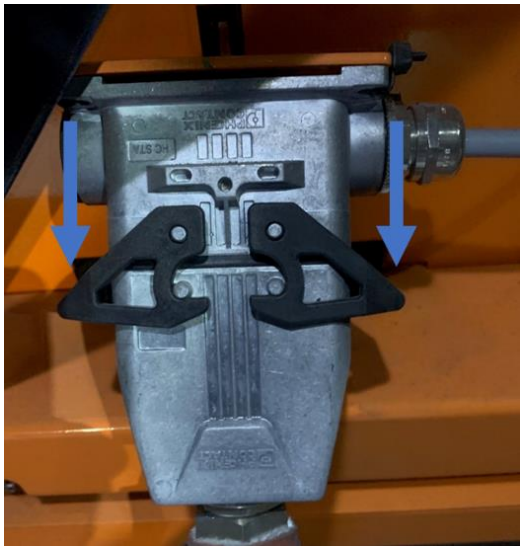
11.3.3.2 Remove Wire from Feeder

- Place the Local Control in MANUAL and REVERSE Switch Positions and retract wire by holding the MOVE Button until it stops moving.
- After the wire stops moving, it can be pulled from the back of the feeder.



11.3.3.3 Disconnect the Pyro Box Cable

- The pyro box cable connects on the right side of the coil.
- Release the black latches to detach the pyro box cable from the coil.



11.3.3.4 Remove the Empty Coil from the Operational Location

- Use lifting straps by running them underneath the orange base and around the top of the coil. Use both sides to connect them to a crane or a lift.
- Remove the coil from the coil operational location.

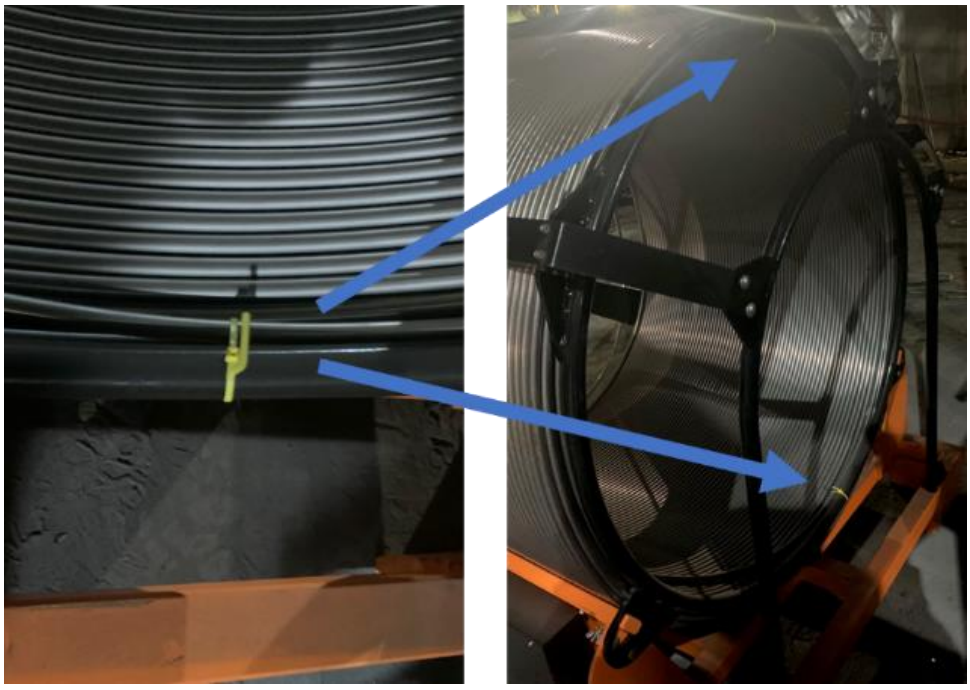
11.3.4 Prepare the New CoreTemp Coil for Installation

11.3.4.1 Fly the New Coil to the Operational Location

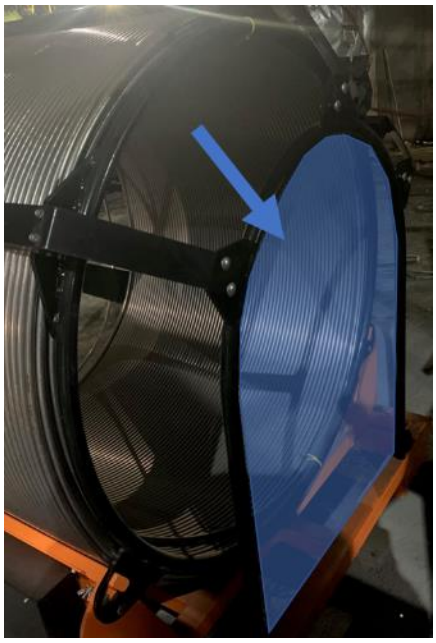
- Use lifting straps by running them underneath the orange base and around the top of the coil. Use both sides to connect them to a crane or a lift.
  - It is recommended to strap under the coil package, as pictured below, but it is also possible to lift with a strap through the coil. It must be a 3” or wider strap. If a cable is used, this will damage the cored wire and could make the coil unusable.

- Move the new coil to the coil operational location.

11.3.4.2 Remove the pull ties that secure the end of the cored wire



11.3.4.3 Put the new coil into the operational location and exit the wire from the through the mouse-hole



!	**Important Note:** • Do not connect the Pyro Box Cable until the wire is fed to the furnace. Connecting the cable early can result in errors in the calculation of the coil length.

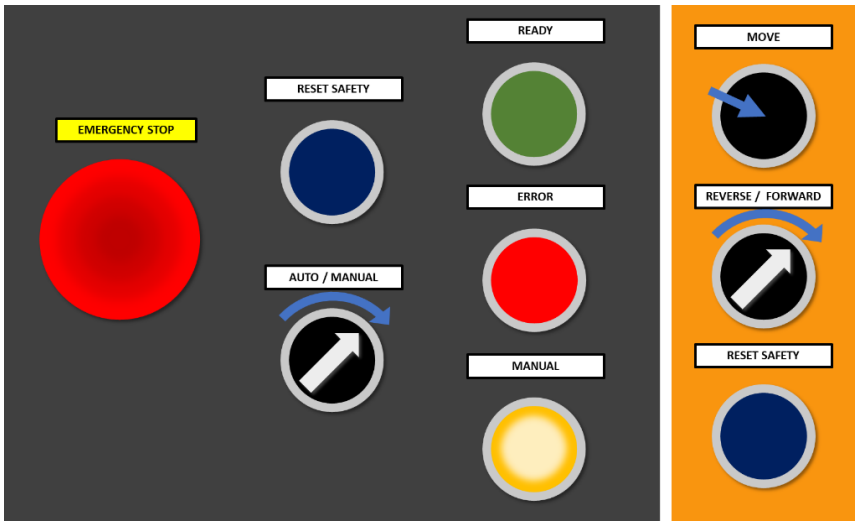
11.3.5 Install the New CoreTemp Coil

11.3.5.1 Route the wire through any roller/wire guides and up to the feeder

11.3.6 Feed Cored Wire to the Furnace

11.3.6.1 Insert the Cored Wire with into the Feeder

- Use Local Control to feed the wire forward until the RESET SAFETY light begins to blink.

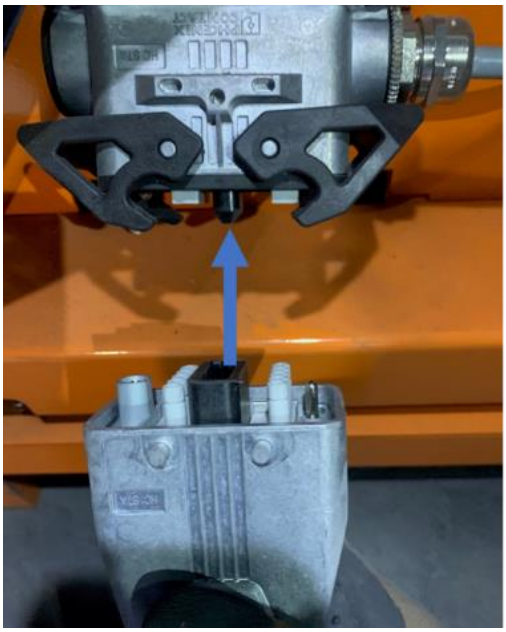


⚠	**Warning:** • Ensure that other operators are clear of CoreTemp coil, feeder, and blowing lance before feeding the cored wire

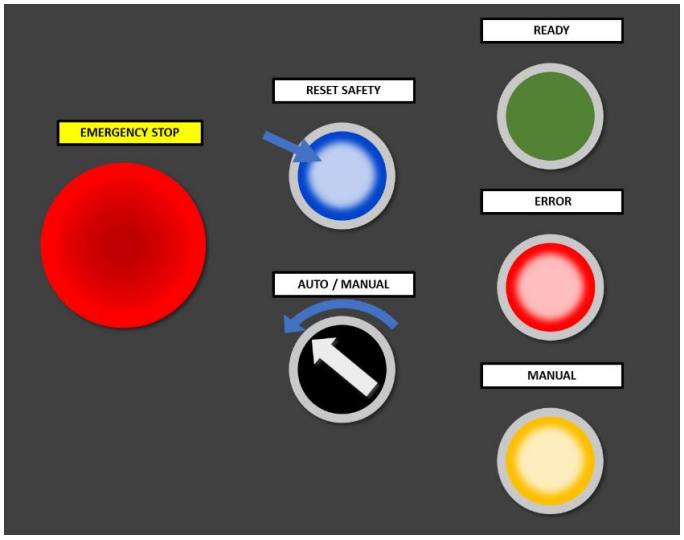
!	**Important Note:** • Never use Measurement Functions to feed Cored Wire. • The wire should only be fed with the Local Control.

11.3.7 Connect the New CoreTemp Coil to the Control Unit

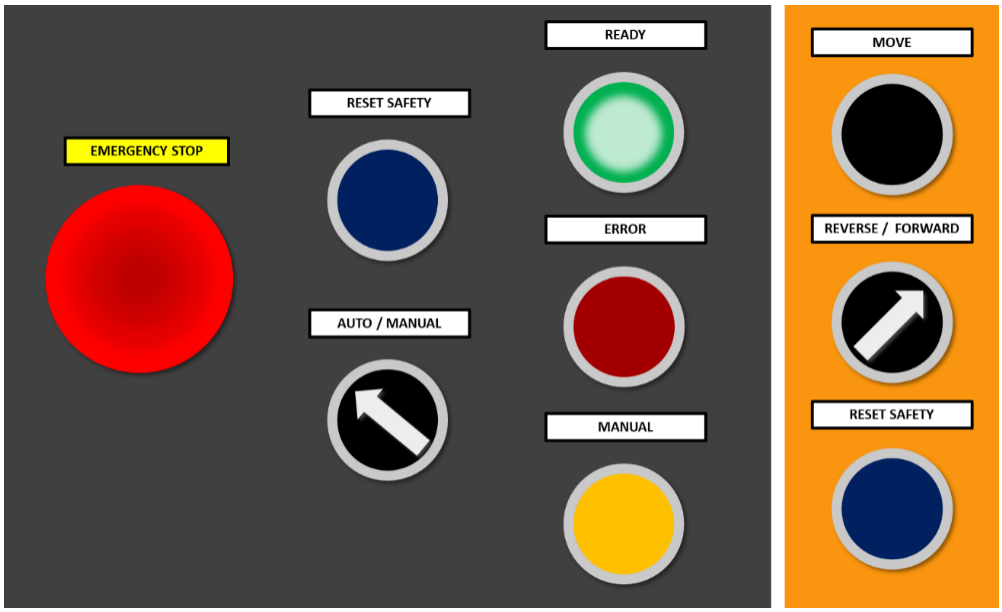
11.3.7.1 Connect the New CoreTemp Coil Pyro Box Cable

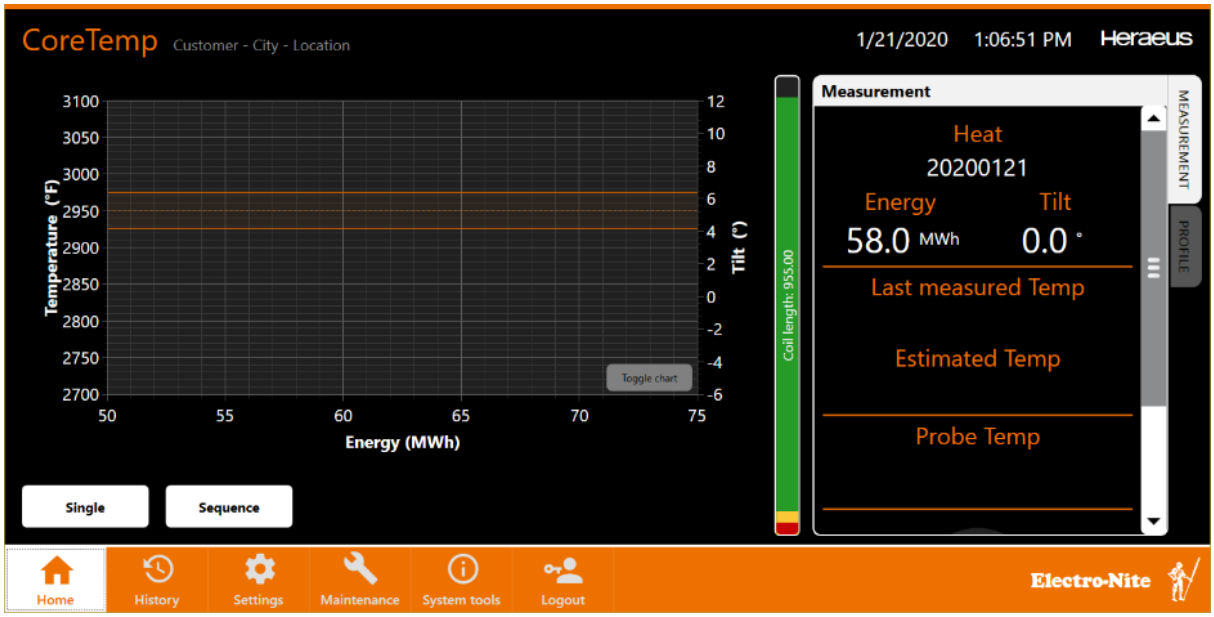


- Set the ‘Auto-Manual’ Switch to Auto and press either RESET SAFETY button.



11.3.8 System is Ready to Measure





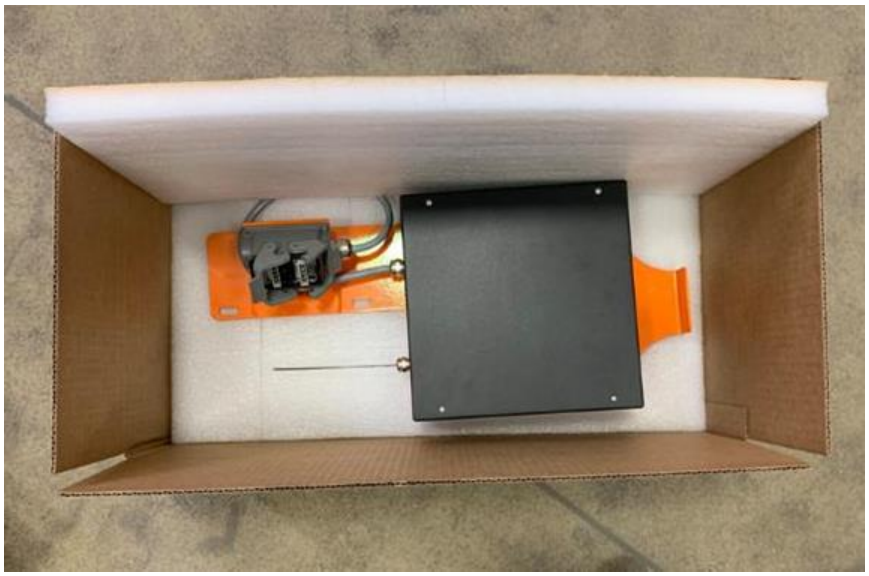
11.3.9 Pyrobox Removal

!	**Important Note:** • Check with the local Heraeus Electro-Nite representative for options on Pyrobox recycling. • The Pyrobox must be returned undamaged and in working condition for recycling credit.

1. Cut the plastic tube, which contains a small metal tube.
2. Remove the 2 wingnuts and bolts.
3. Pull pyrobox plate with connector from coil frame.

11.3.9.1 Pyrobox Return

- Place the plate holding the Pyrobox assembly inside of the supplied return packaging.
- Return to Heraeus Electro-Nite.



11.4 Guide Pipe, Roller Straightener, Blowing Lance Assembly

All CoreTemp Installation can have differences in the guide pipe configuration and components. The following is a general procedure to assemble the CoreTemp Guide Pipes and associated components.

When disassembling the components, it would be necessary to follow these steps in the reverse order.

Before you begin:

Personnel:

Number of workers: 1
Skill level: Furnace crew
Time estimate: 10 min

Equipment:

- No tools required.

Material:

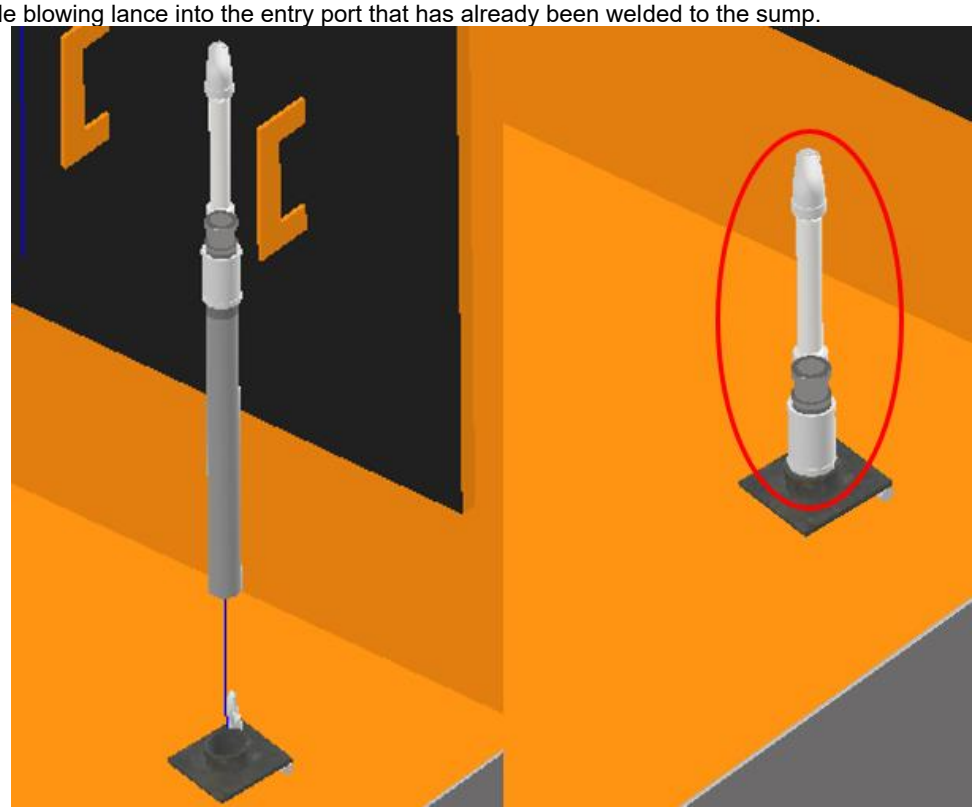
- Consider spare guide pipe components, Roller Straightener, Blowing Lance depending on the cause of the maintenance intervention.

Safety:

⚠	**Warning:** • Follow site-specific Lock Out procedure • Proper Personal Protective Equipment should be used for all process steps • Operators should not contact the CoreTemp Coil or Equipment during furnace arcing.

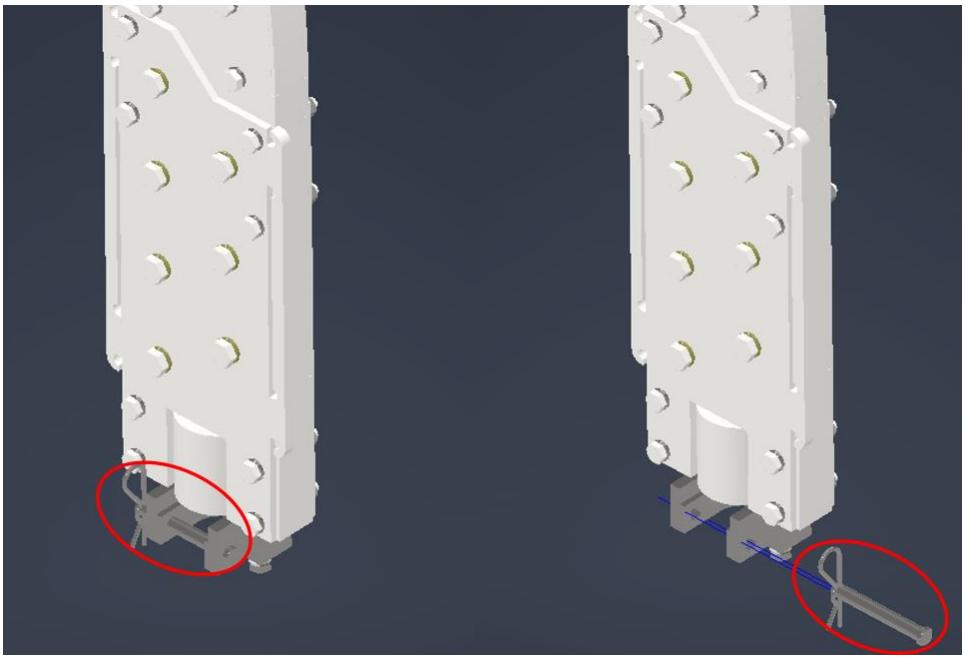
11.4.1 Blowing Lance Installation

1. Insert blowing lance into entry port.
   a. Slide blowing lance into the entry port that has already been welded to the sump.

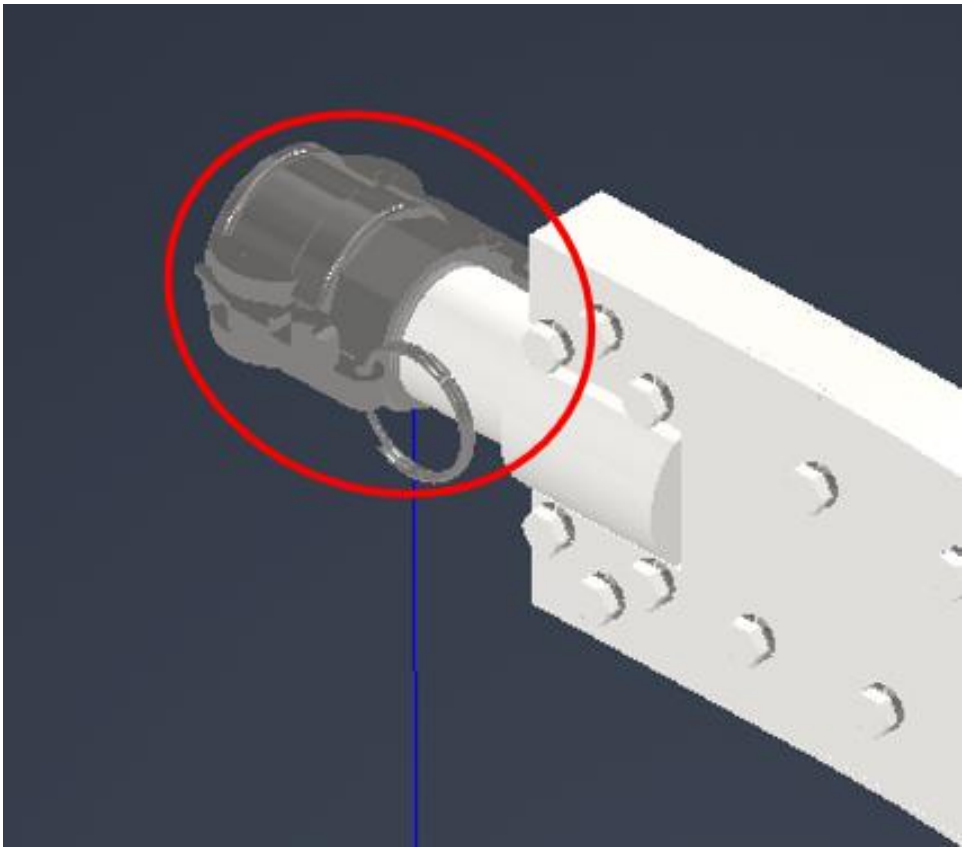


11.4.2 Roller Straightener Installation

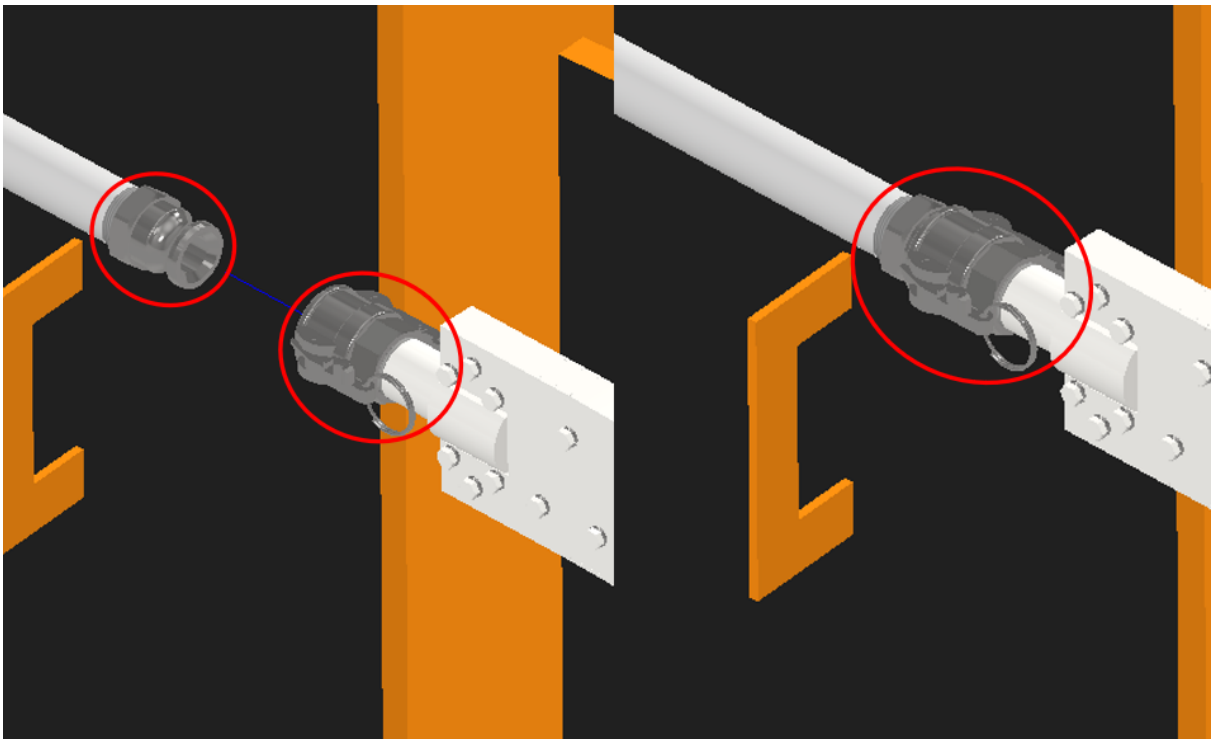
1. Prep roller straightener for installation.
   a. Remove blowing lance pin from roller straightener and save for installation.



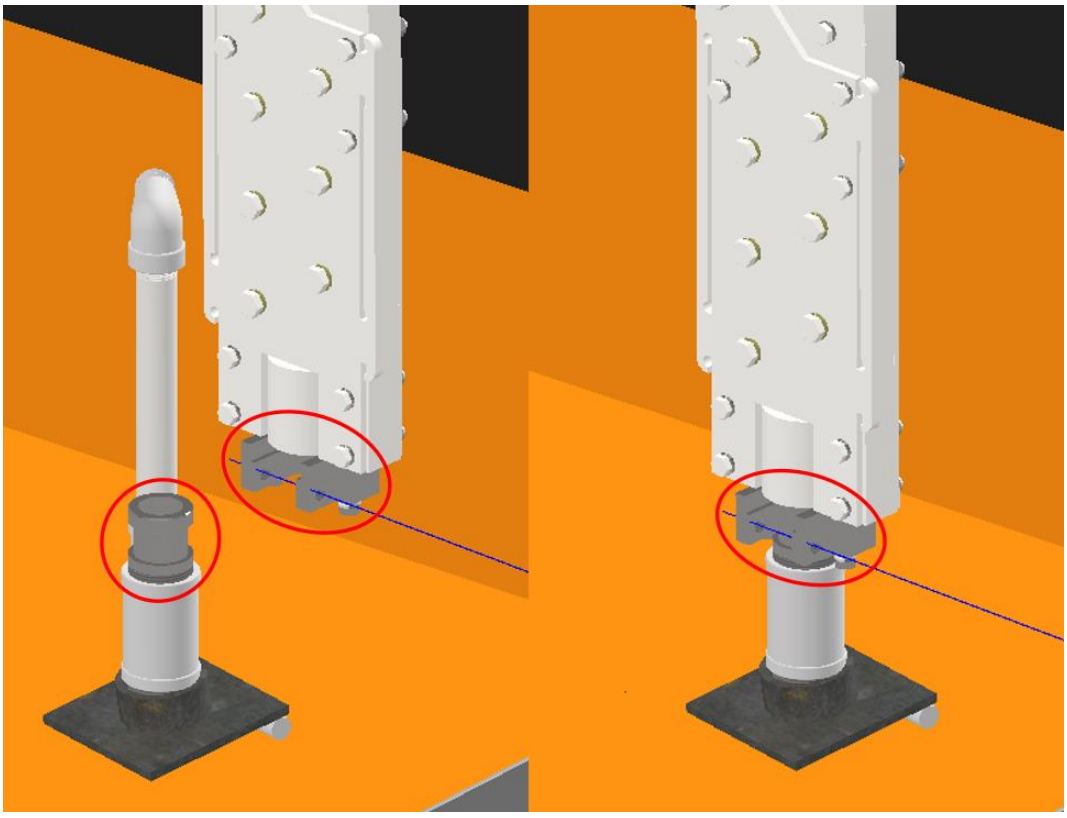
   b. Open the female cam lock on the roller straightener.



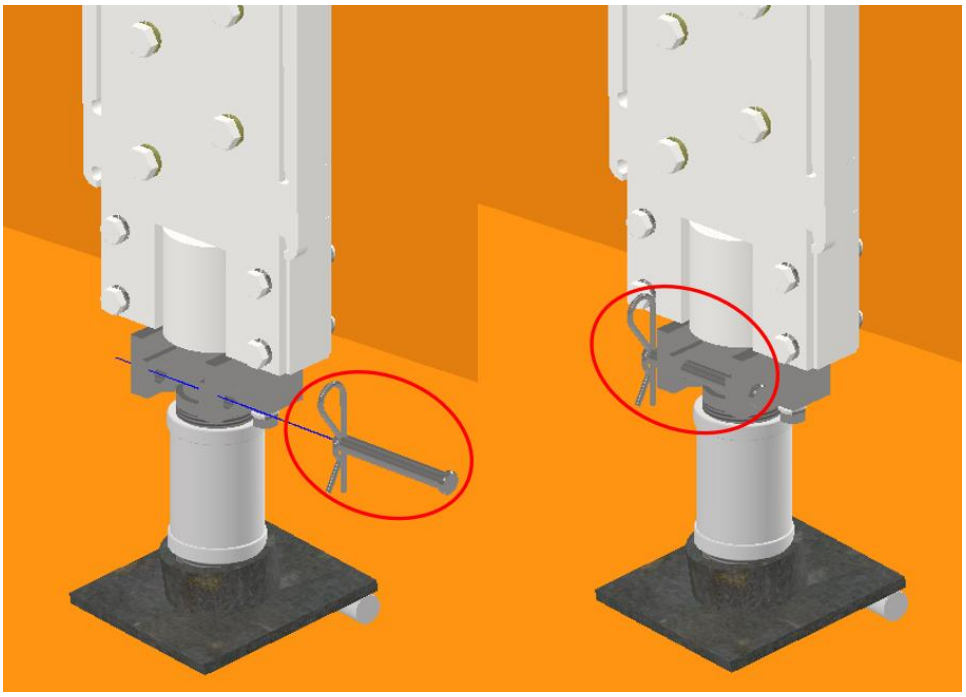
2. Roller straightener installation
   a. Connect the female cam lock on the roller straightener with the male cam lock on the guide pipe.



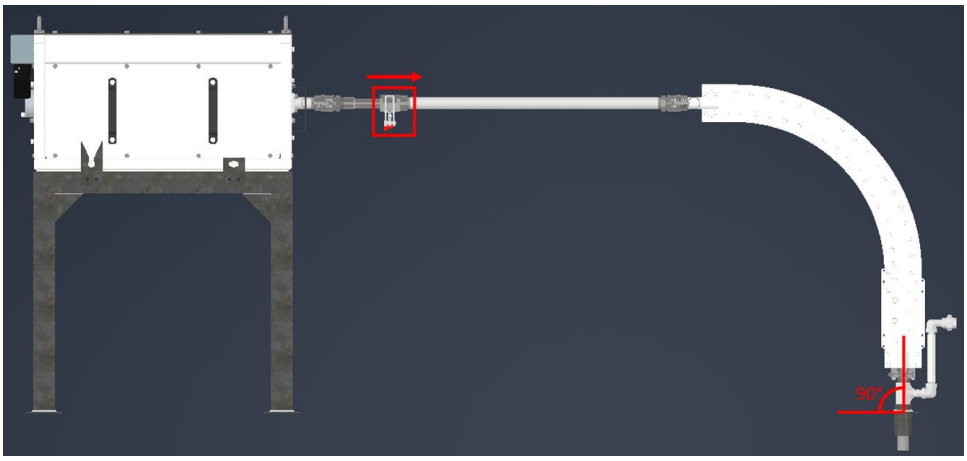
   b. Slide the roller straightener clamp onto the blowing lance adaptor.



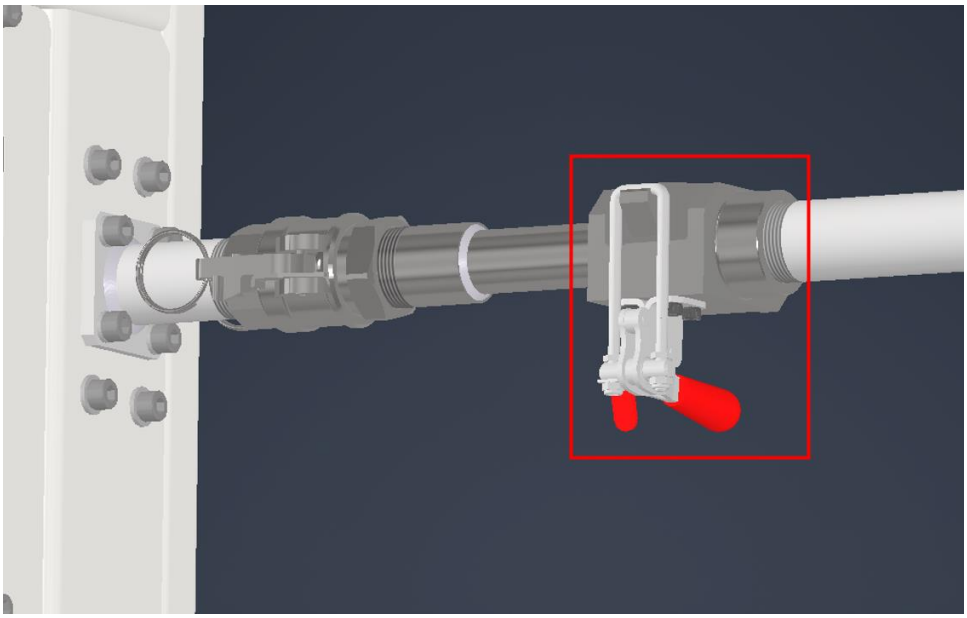
c. Insert the blowing lance pin back into the roller straightener clamp.



d. Slide the open extendable guide pipe clamp forward until roller straightener entry is at a 90-degree angle.



e. Once it is in place, latch the extendable guide pipe clamp to secure it.



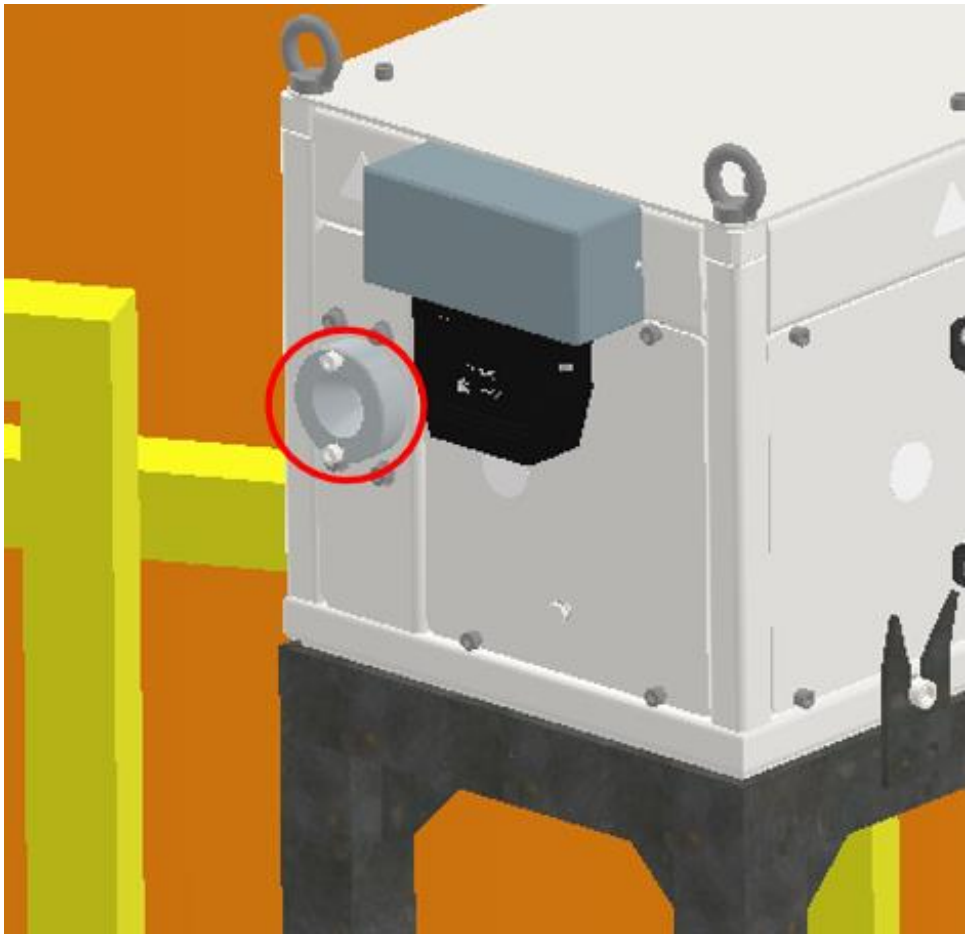
11.4.3 Connect Air and Feed Wire into Furnace

1. Connect air to blowing lance.
   a. Connect ¾ inch airline on sump to blowing lance.

   b. Turn on ¼ inch ball valve near sump to supply air to the blowing lance. Ensure that air is flowing and that there is not another valve closed in the system.

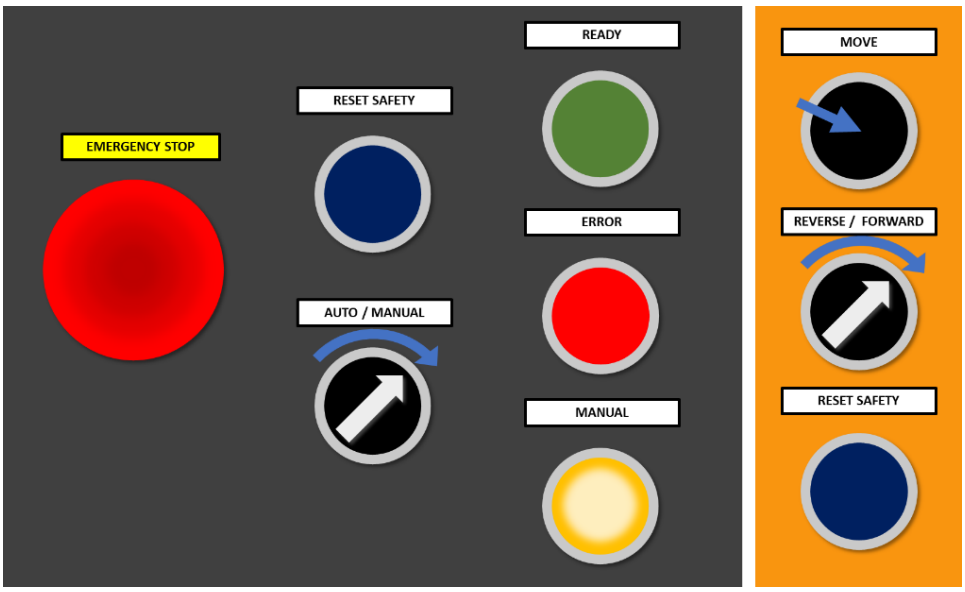
11.4.4 Feed wire into the furnace.

1. Insert cored wire into the feeder inlet.

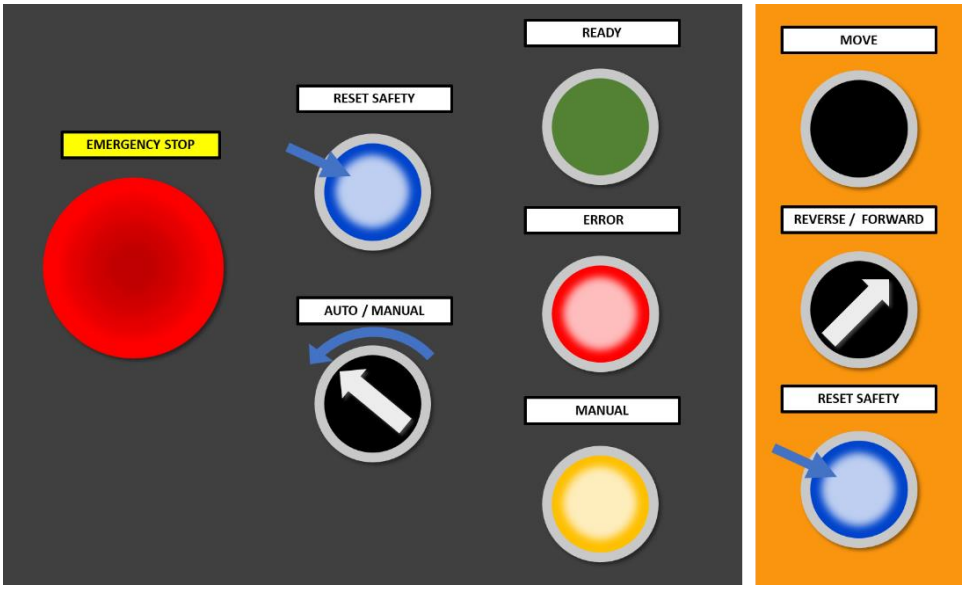


2. Place the Local Control in MANUAL mode.

3. Use Local Control to feed the wire forward until the RESET SAFETY light begins to blink.



4. Set the ‘Auto-Manual’ switch to AUTO and press either RESET SAFETY button.



11.5 Replace the Feeder Cable

Certain sequences of errors can give a good indication that there is damage to the cables between the CoreTemp Feeder and Control Unit. It is always advisable to check with your Heraeus Electro-Nite Representative before changing the Feeder Cable.

Before you begin:

Personnel:

Number of workers: 2
Skill level: Electrical Maintenance
Time estimate: 30 min

Equipment:

- M6 Allen wrench
- Flat and Philips screw drivers

Material:

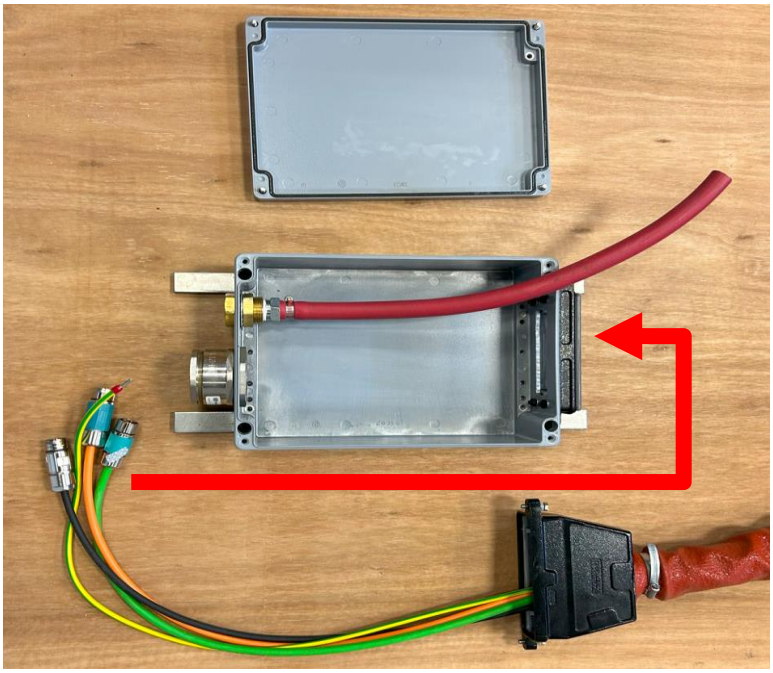
- Replacement Feeder Cable
  - Bolts to connect Cable to Feeder are supplied (M8 x 1.25mm Thread, 45mm Long)

Safety:

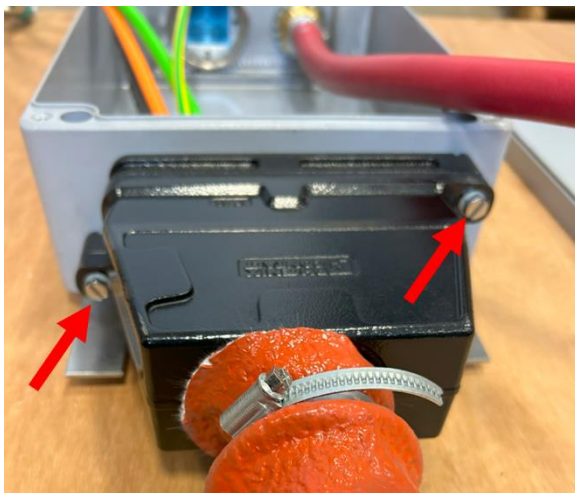
⚠	**Warning:** • Follow site-specific Lock Out procedure • Proper Personal Protective Equipment should be used for all process steps • Operators should not contact the CoreTemp Coil or Equipment during furnace arcing.

11.5.1 Air-cooled Feeder Cable to Junction Box

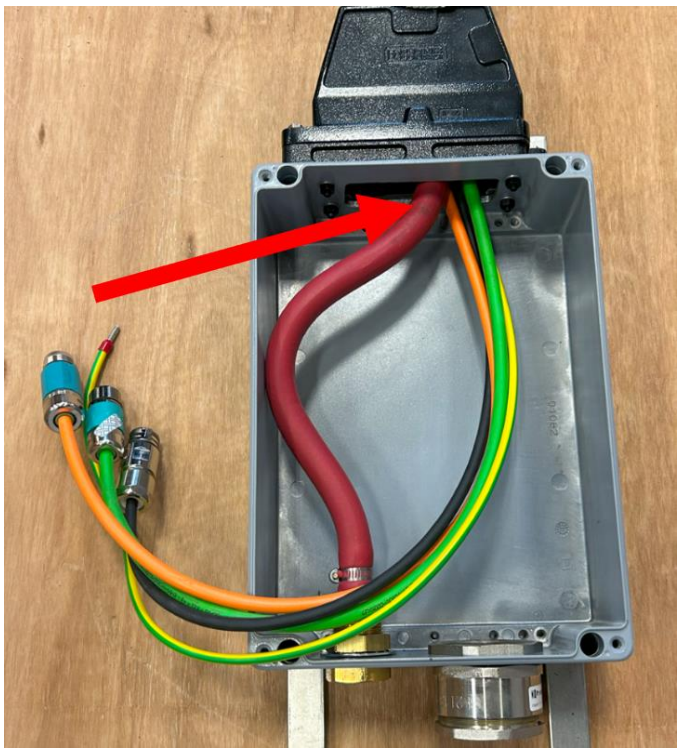
1. Insert cables from feeder cable assembly through the opening with the base that matches the cable assembly's housing.



2. Mate the housing (hood) to the base and tighten screws.



3. Insert the rubber air line into the Feeder cable assembly hose.

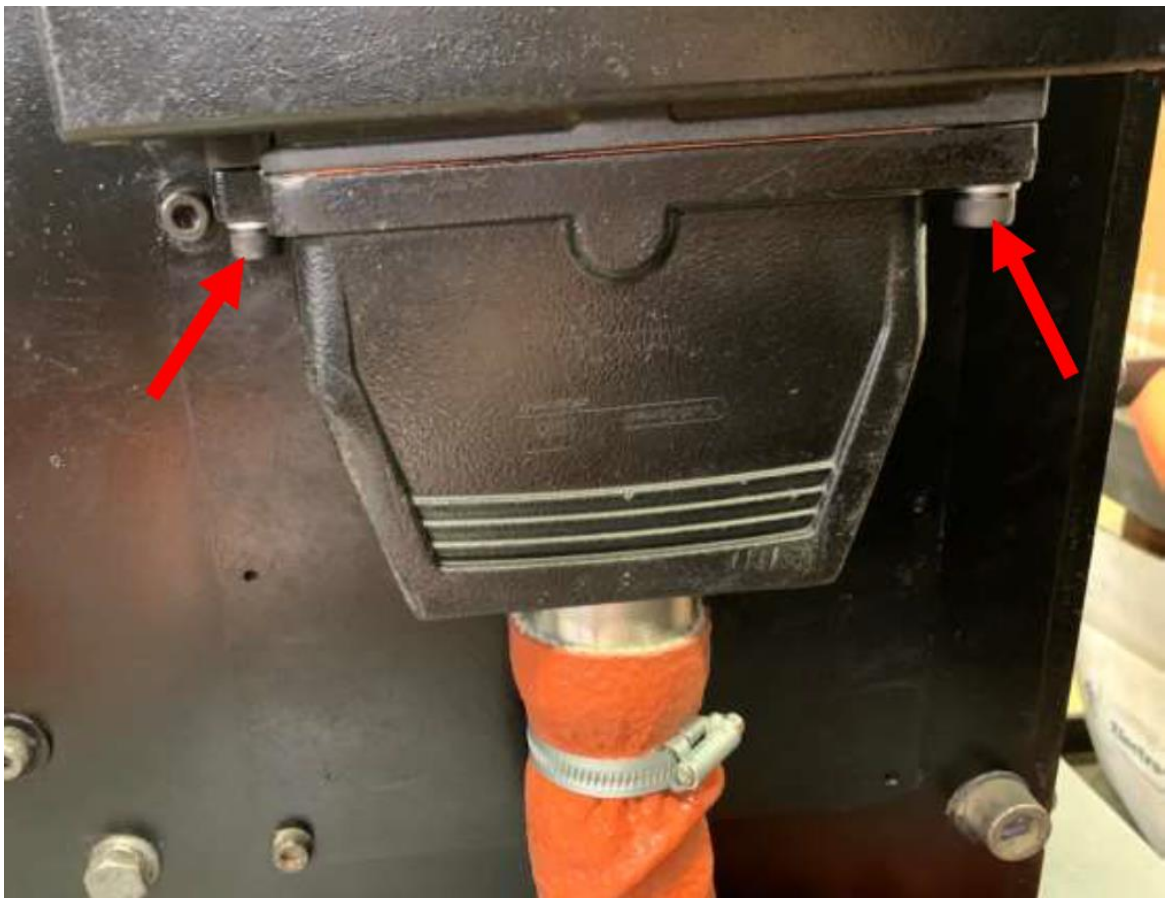


4. Connect cables.

11.5.2 Air-cooled Feeder Cable to Feeder

1. Feeder side quick connect.

2. Connect to feeder. Bolts: (2)M8x1.25 50mm



11.6 Replace the Feeder

CoreTemp Feeders contain traction plates which drive the cored wire. Over time, the traction plates will wear – which allows the drive wheels to slip on the cored wire during feeding. When the slip reaches a certain level, maintenance actions must be performed on the Feeder. In most cases, the best course of action will be to remove the Feeder from service and perform the maintenance offline.

Before you begin:

Personnel:

Number of workers: 2
Skill level: Electrical Maintenance
Time estimate: 30 min

Equipment:

- M6, M14 Allen wrench

Material:

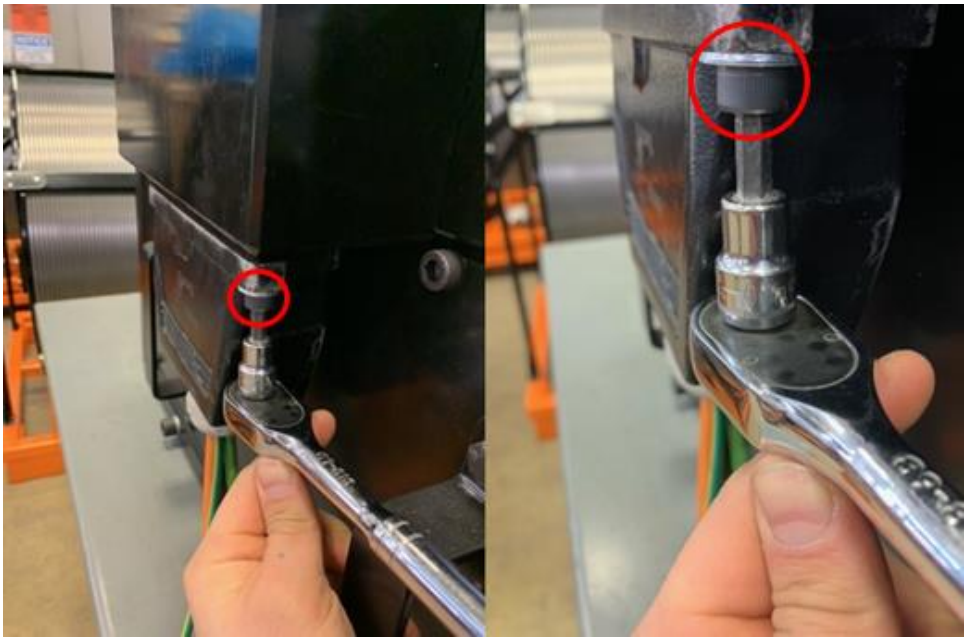
- Replacement Feeder Cable
- Hardware List
  - Feeder Cable to Feeder (2x M8 x 1.25mm Thread, 45mm Long)
  - Feeder to Stand (4x M16 x 2mm Thread, 30mm Long)

Safety:

⚠	**Warning:** • Follow site-specific Lock Out procedure • Proper Personal Protective Equipment should be used for all process steps • Operators should not contact the CoreTemp Coil or Equipment during furnace arcing.

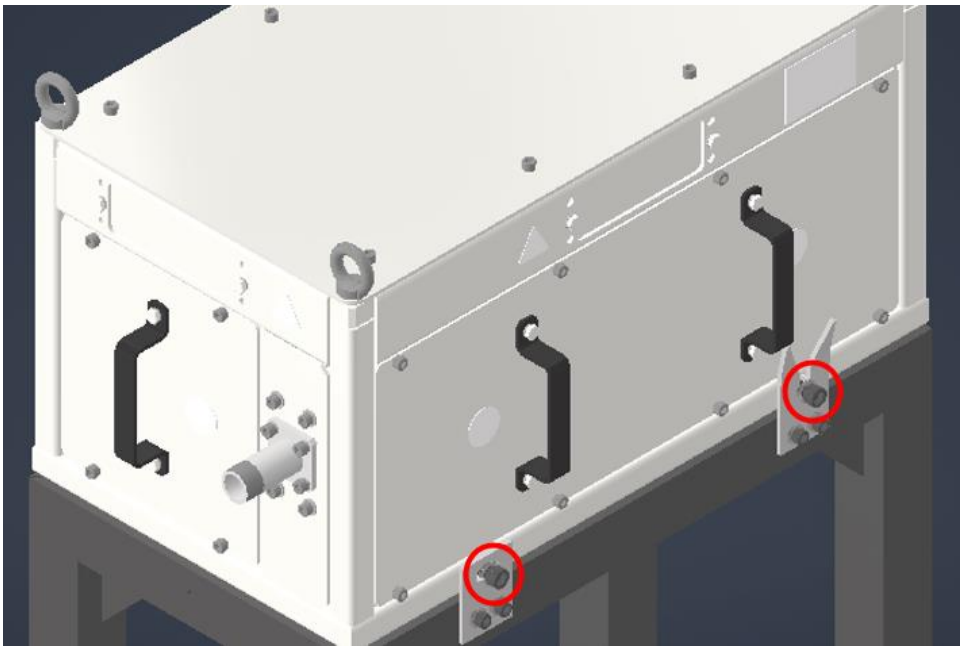
11.6.1 Remove OLD Feeder from Feeder Stand

1. Remove the two M8 bolts (M8 x 1.25mm Thread, 45mm Long) that hold the feeder cable to the feeder.
   a. Use a 6mm Allen wrench:



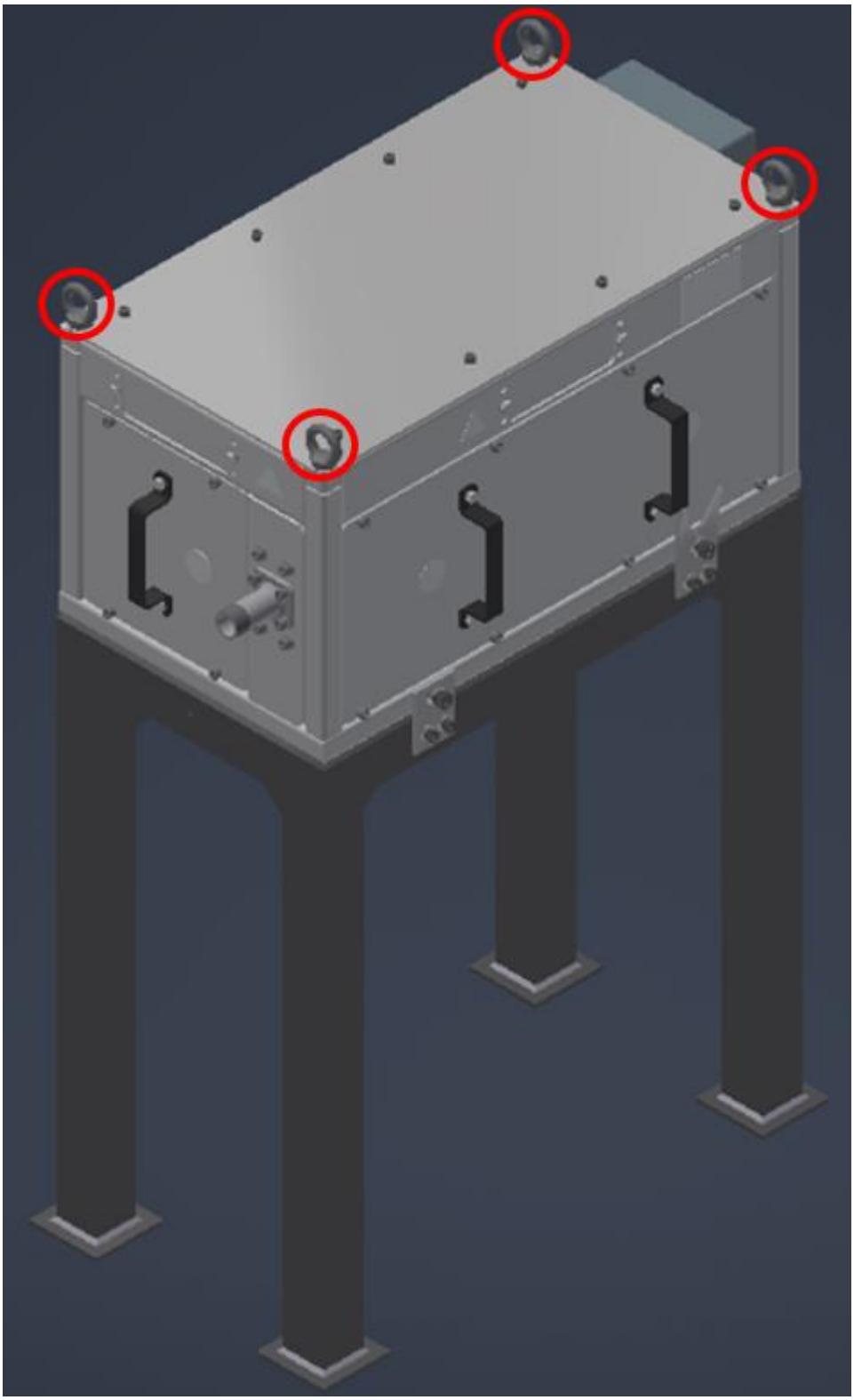
   b. Remove the feeder cable from the feeder.

2. Loosen and remove the four M16 bolts (M16 x 2mm Thread, 30mm Long) that hold the feeder to the feeder stand.
   a. Use a 14mm Allen wrench:



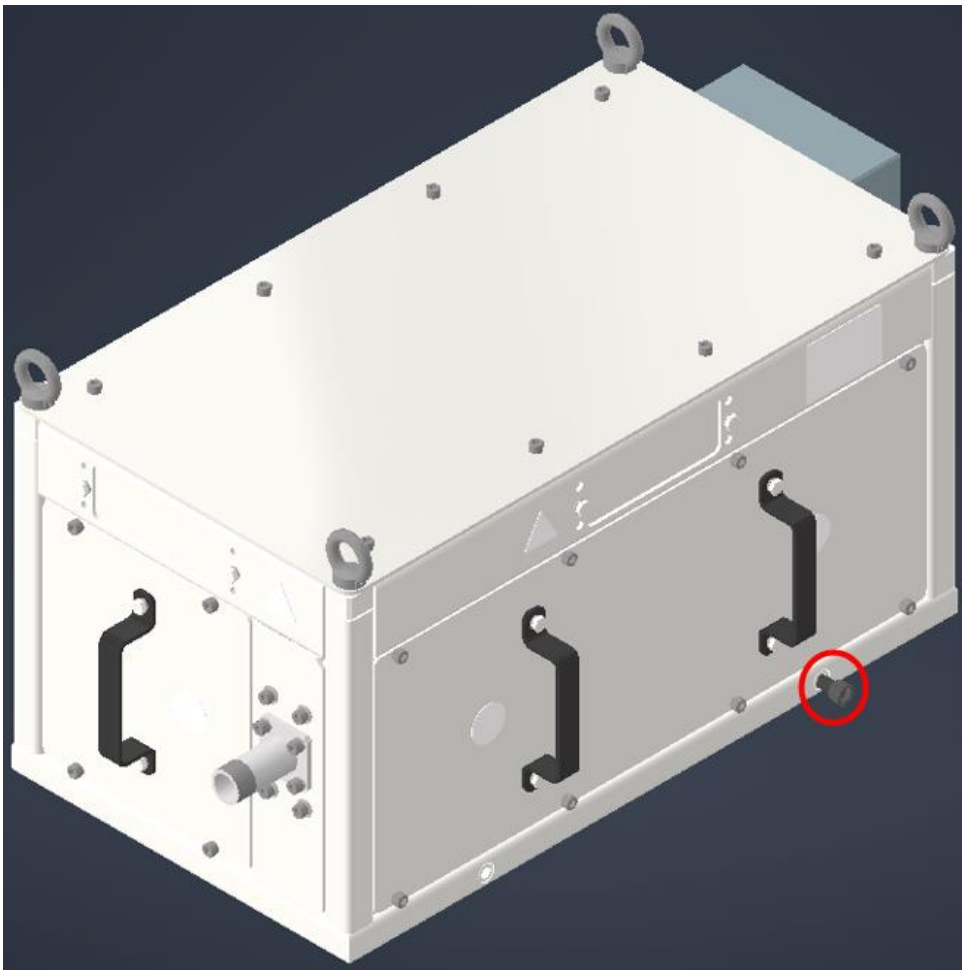
   b. Save them for the new feeder.

3. Use lifting straps in combination with ALL the eye bolts on top of the feeder to safely lift the OLD feeder up and off the feeder stand with a crane.
   a. Move the feeder to another location:

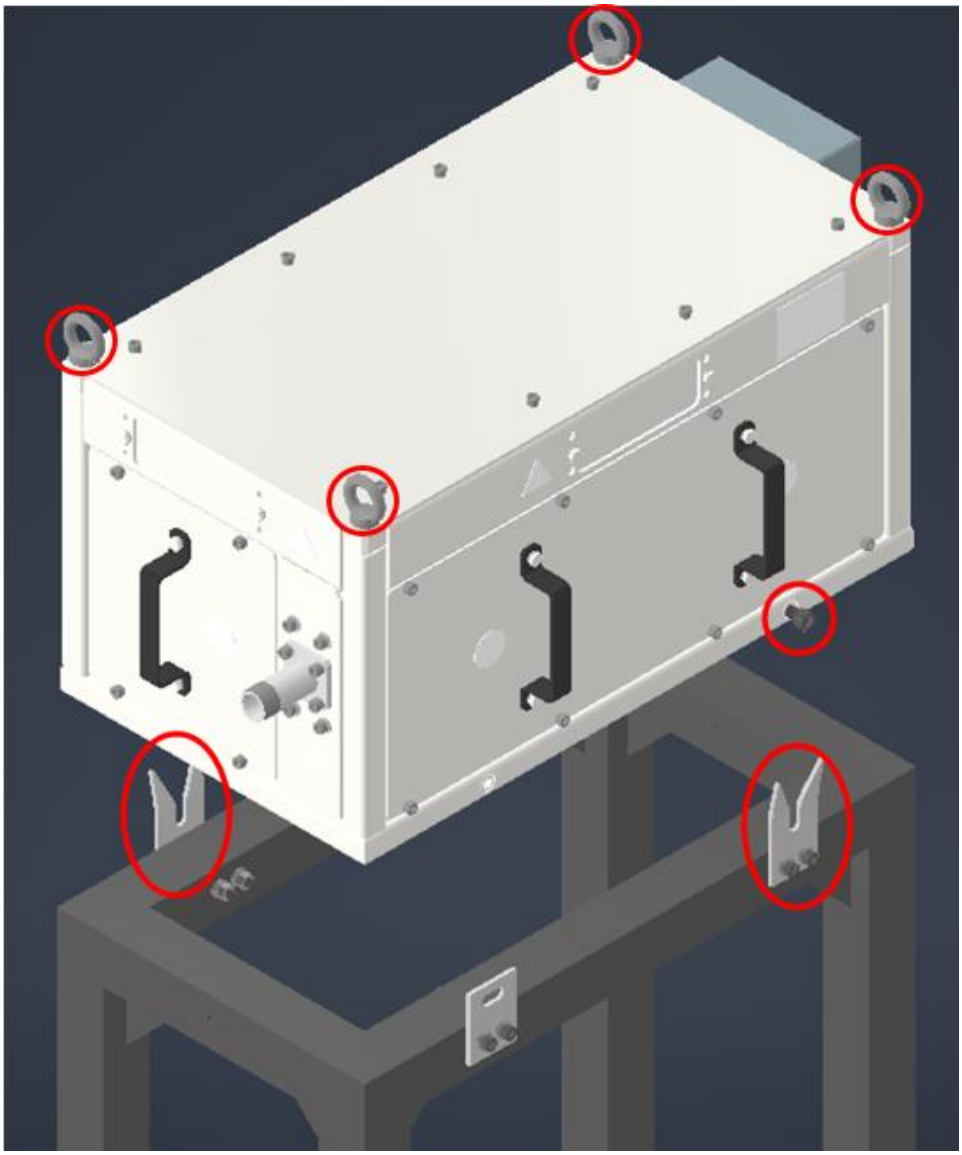


11.6.2 Place NEW Feeder on Feeder Stand

1. Prep Feeder for Installation onto Stand.
   a. Thread the two supplied M16 bolts (M16 x 2mm Thread, 75mm Long) into the feeder in the correct orientation that they line up with the locating plates. Leave about 40mm of thread exposed for the bolt to slide into the locating plate.

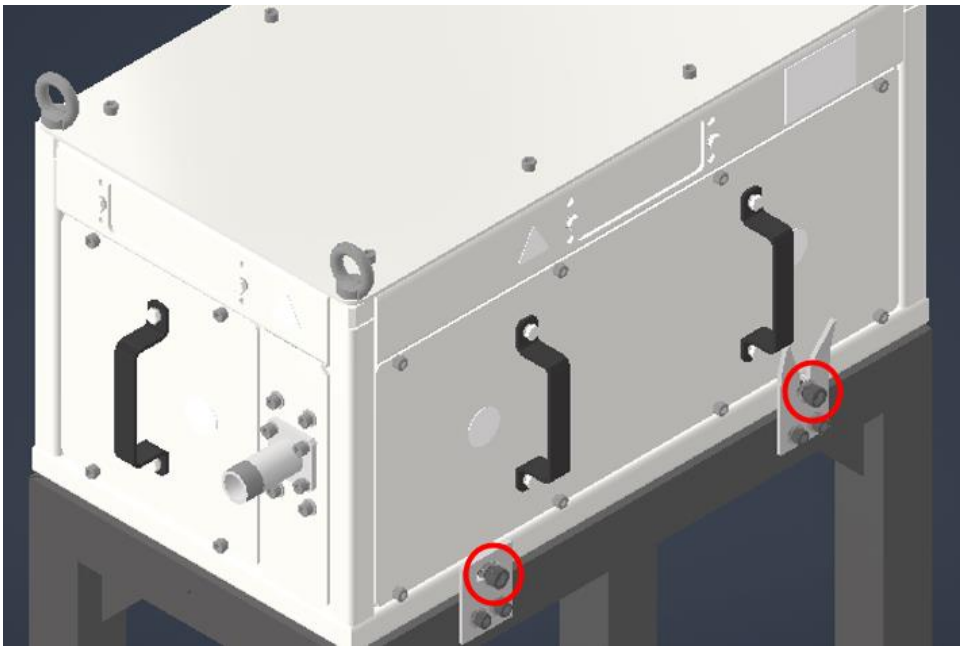


2. Install the Feeder onto the Feeder Stand.
   a. Use a lift, forklift, or a crane to safely suspend the feeder using ALL the eye bolts.
   b. Lower the feeder onto the feeder stand and ensure that the bolts are lined up with the locating plates.



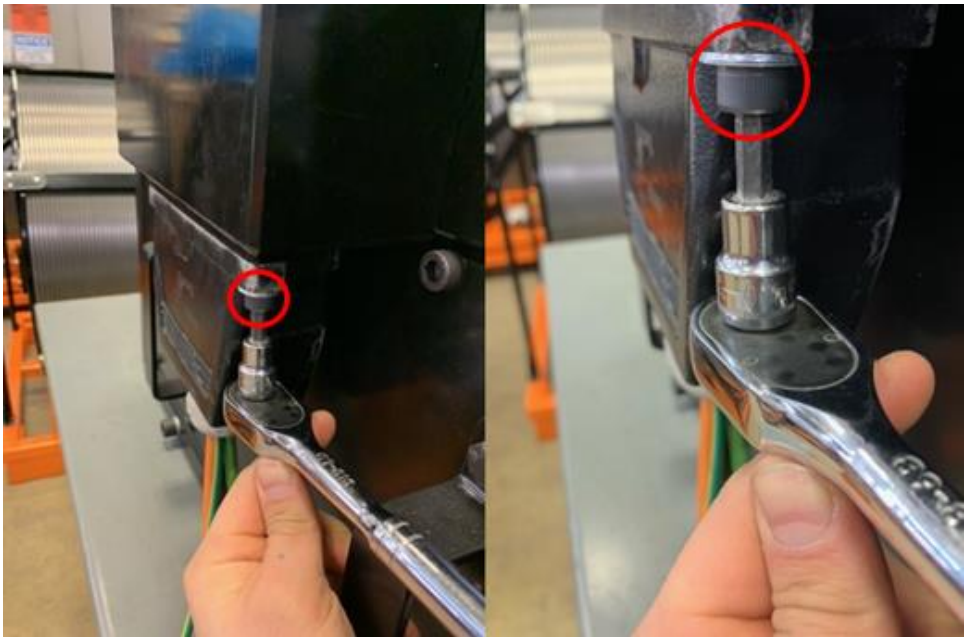
   c. Safely set the feeder on the stand.

3. Replace and Tighten the Bolts.
   a. Remove the two M16 bolts (M16 x 2mm Thread, 75mm Long) that were used to guide the feeder onto the stand.
   b. Once the new feeder is onto the feeder stand ensure that all four M16 holes on the new feeder are lined up with the feeder stand bracket slots.
   c. Loosely screw all four M16 bolts (M16 x 2mm Thread, 30mm Long) from section 2.2b through the feeder stand brackets and into the new feeder:

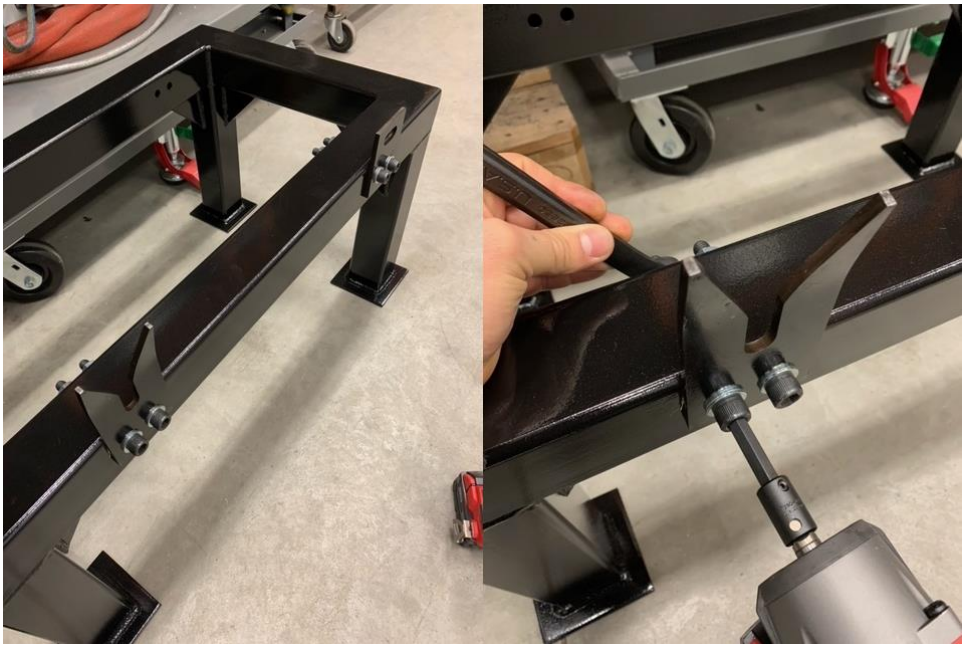


   d. Tighten all four M16 bolts (M16 x 2mm Thread, 30mm Long) with a 14mm Allen wrench.

4. Plug the feeder cable into new feeder and loosely thread both M8 bolts (M8 x 1.25mm Thread, 45mm Long) into the feeder by hand.
   a. Tighten both M8 bolts (M8 x 1.25mm Thread, 45mm Long) progressively by alternating to and from each bolt with a M6 Allen wrench until both are snug.



5. OPTIONAL: If the feeder is not moving easily when using the crane to take off the old feeder or put on the new feeder, do the following:
   a. Use a 19mm wrench or socket in combination with a 10mm Allen wrench to loosen the feeder stand mounting brackets. Brackets are held on by M12 bolts (M12 x 1.75mm Thread, 110mm Long):



   b. Tighten the M12 bolts (M12 x 1.75mm Thread, 110mm Long) back up once the new feeder is in place.

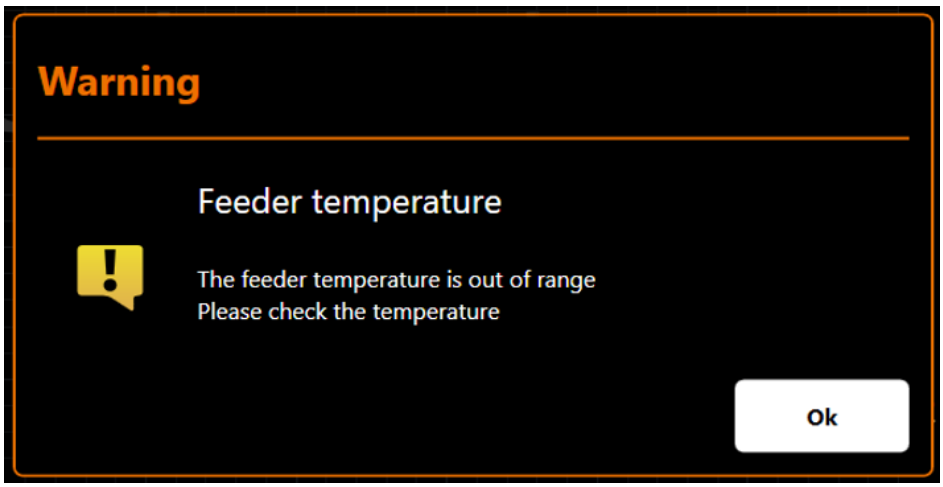
6. You have now completed this CoreTemp feeder change.

11.7 Motor Temperature Sensor

After a Feeder Replacement it is possible that the system no longer recognizes the temperature sensor in the motor of the new unit.

- CoreTemp Feeders (31110062) Type [2] Temp Sensor
- CoreTemp Feeders (32000965) Type [6] Temp Sensor

The following warning will be displayed on the CoreTemp Software:



!	**Important Note:** • Type [2] Temp Sensor is programmed into the Drive for a Feeder with Type [6] Temp Sensor: the System will not show any other error and will be able to run in manual and auto. • Type [6] Temp Sensor is programmed into the Drive for a Feeder with Type [2] Temp Sensor: the System will give Motor Drive Error 421, and will not be able to run in manual or auto.

This panel has six push buttons and an LCD display.

!	**Important Note:** • **E-Stop the system** – changes will not be saved if in run mode.

1. Press 1 x [P] display gives r00000

2. Press 2 x [△] display gives P00003

3. Press 1 x [P] display gives 1,2, or 3
   a. (if display shows 3, go to step 6)

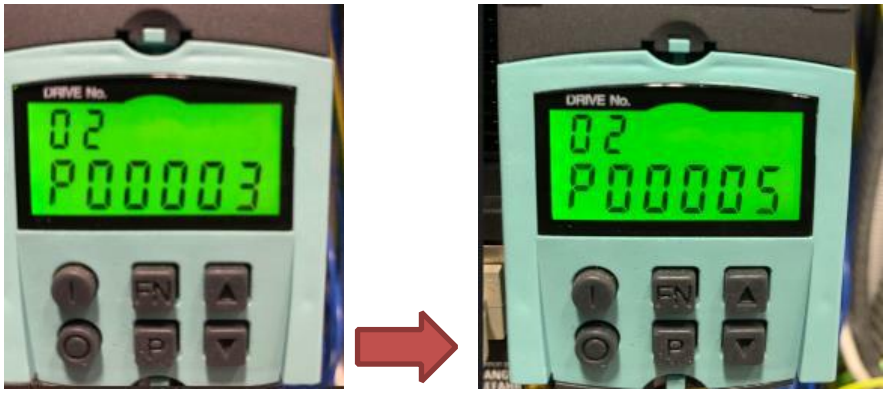
4. Press 1 x FN 1,2, or 3 starts flashing

5. Press △ set this number to 3

6. Press 2 x P display shows P00003

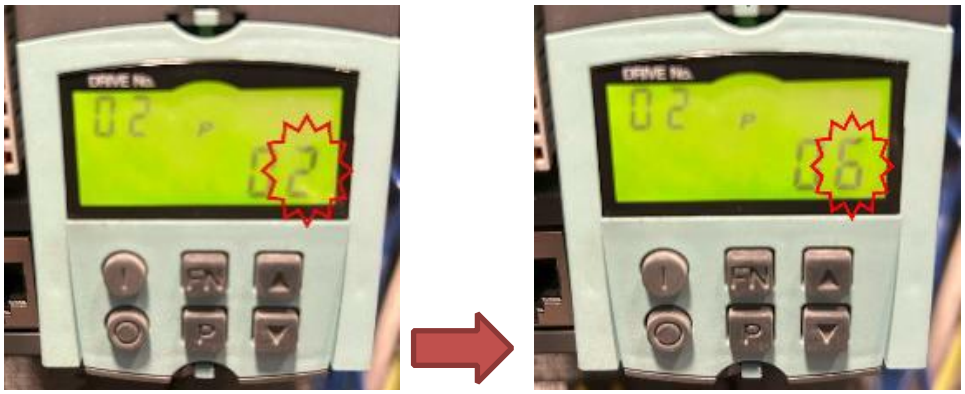
7. Press FN and △ simultaneously,
   a. number 01 in top left corner flashes

8. Press 1 x △ the number is now 02 and press 1 x P



9. . Press and hold △ until P00601
   a. Then press 2 x P the display shows a number (2) or (6)
      i. [2] KTY84
      ii. [6] PT1000

10. Now press FN and the digit you want to change starts flashing.
    a. Press △ or ▽ until the desired number is shown. (2) or (6)



11. Press 2 x P

Put new settings in memory.

To keep the setting in memory when the device is switched off the new setting must be saved. To do this:

1. Press P for about 3 s the screen will flash twice. This means that the settings are stored from the RAM to the ROM.
2. Switch off the power supply to the system, wait for 10 seconds, and switch system back on.
3. Press blue Reset button when light is on.

Now the machine is ready to run.

11.8 Drive Voltage Selection

Set the voltage to match the main power supply.

- 380VAC-480VAC +/-10%

!	**Important Note:** • Error F06310 appears on the drive if the voltage is set incorrectly.

This panel has six push buttons and an LCD display.

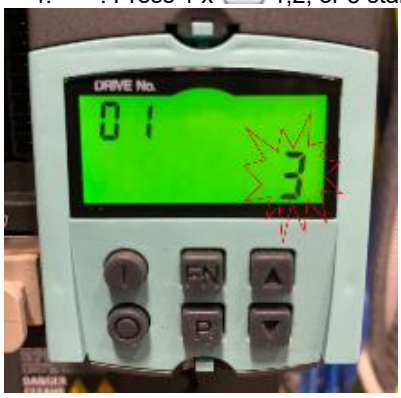
!	**Important Note:** • **E-Stop the system** – changes will not be saved if in run mode.

1. Press 1 x P display gives r00000

2. Press 2 x △ display gives P00003

3. . Press 1 x P display gives 1,2, or 3
   a. (if display shows 3, go to step 6)

4. . Press 1 x FN 1,2, or 3 starts flashing



5. . Press △ set this number to 3
   a. (Access level)

6. Press 2 x P display shows P00003

7. Press FN and △ simultaneously,
   a. number 01 in top left corner flashes

8. Press 1 x △ the number is now 02 and press 1 x P

9. Press and hold △ until P00210
   a. Then press 1 x P the display shows a number 380 through 480

10. Now press FN until the digit you want to change starts flashing.
    a. Press △ or ▽ until the desired number is shown. (i.e., 440, 480)

11. Press 2 x P

Put new settings in memory.

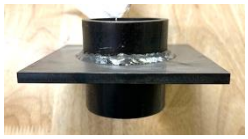
!	**Important Note:** • To keep the setting in memory when the device is switched off the new setting must be saved.

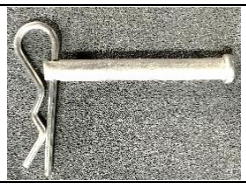
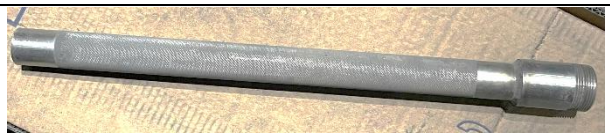
1. Press P for about 3 s the screen will flash twice. This means that the settings are stored from the RAM to the ROM.
2. Switch off the power supply to the system, wait for 10 seconds, and switch system back on.
3. Press blue Reset button when light is on.

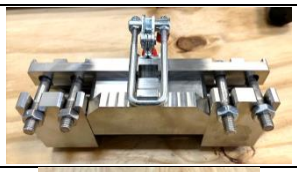
Now the machine is ready to run.

12 Spare Parts

If repairs are necessary, contact your local Heraeus Electro-Nite sales representative.
Certain repairs and replacements to the system can only be done by qualified Heraeus Electro-Nite personnel.
Heraeus Electro-Nite will provide a list of the required spare parts for a specific installation.

Description: CW ENTRY PORT 0 DEG 03CM WCP **HEN UCS:** 82821021 **HEN HSAL:** CW3HEP0003WCP	
Description: CW ENTRY PORT 8 DEG 04CM **HEN UCS:** 82816021 **HEN HSAL:** CW3HEP0804	
Description: CW ENTRY PORT 0 DEG 03CM **HEN UCS:** 82815021 **HEN HSAL:** CW3HEP0003	
Description: PKG CW BLOWING LANCE ASSY 17CM **HEN UCS:** 80913861 **HEN HSAL:** CW3HBL17	
Description: PKG CW BLOWING LANCE ASSY 45CM **HEN UCS:** 80909861 **HEN HSAL:** CW3HBL45	
Description: PKG CW BLOWING LANCE ASSY 91CM **HEN UCS:** 80915561 **HEN HSAL:** CW3HBL91	
Description: CONN MALE CAM LOCK **HEN UCS:** 83978811 **HEN HSAL:** CW3HGTCAMM	
Description: CONN FEM CAM LOCK **HEN UCS:** 83981111 **HEN HSAL:** CW3HGTCAMF	

Description: CW ROLLER STRAIGHTENER - 32IN **HEN UCS:** 80913721 **HEN HSAL:** CW3ARS32 **Description:** CW ROLLER STRAIGHTENER – 39IN **HEN UCS:** 39010028 **HEN HSAL:** CW3ARS	
Description: CW ROLLER STRAIGHTENER SHORT **HEN UCS:** 80915621 **HEN HSAL:** CW3ASRS	
Description: CW BLOWING LANCE CLEVIS PIN KIT **HEN UCS:** 80872521 **HEN HSAL:** CW3HBLRP	
Description: PKG CW GUIDE TUBE SCH40 226CM **HEN UCS:** 82820761 **HEN HSAL:** CW3HGTAS226 **Description:** PKG CW GUIDE TUBE SCH40 240CM **HEN UCS:** 82821561 **HEN HSAL:** CW3HGTAS240 **Description:** PKG CW GUIDE TUBE SCH40 277CM **HEN UCS:** 82820861 **HEN HSAL:** CW3HGTAS277	
Description: CW GUIDE TUBE 64CM 150CMRAD **HEN UCS:** 81860661 **HEN HSAL:** CW3HGTR064150	
Description: CW EXTENDABLE GUIDE PIPE **HEN UCS:** 80913321 **HEN HSAL:** CW3HGTEXT045	
Description: CW EXTENDABLE GUIDE PIPE FUNNEL **HEN UCS:** 83996411 **HEN HSAL:** CW3HGTEXTFNL	
Description: CW EXTENDABLE GUIDE PIPE TUBE **HEN UCS:** 83996511 **HEN HSAL:** CW3HGTEXTTB45	

Description: CW EXTENDABLE GUIDE PIPE CLAMP ASSY **HEN UCS:** 82821221 **HEN HSAL:** CW3HGTEXTCL	
Description: CW ROLLER CLAMP **HEN UCS:** 82815121 **HEN HSAL:** CW3HGTRCL	
Description: CORETEMP CLAMP FOR CUTTING WIRE **HEN UCS:** 35099410 **HEN HSAL:** CW3HGTCCL	
Description: CORETEMP TUBE CLAMP P1 **HEN UCS:** 21825161 **HEN HSAL:** CW3HGTCL	
Description: CW V3 ADPTR FEEDER OUTLET **HEN UCS:** 83983511 **HEN HSAL:** CW3F3FE	
Description: CW V2 ADPTR FEEDER OUTLET **HEN UCS:** 83983311 **HEN HSAL:** CW3F2FE	
Description: CW CORETEMP PENDANT **HEN UCS:** 80874321 **HEN HSAL:** CW3PEN	
Description: CORETEMP 2 HANDS CONTROL **HEN UCS:** 31110065 **HEN HSAL:** CW3PEN	

Description: Pyro Cable 3, 5, 7.5 & 10M **HEN UCS:** 31220041 **HEN HSAL:** CW3HCPY3 **HEN UCS:** 31220000 **HEN HSAL:** CW3HCPY5 **HEN UCS:** 31220001 **HEN HSAL:** CW3HCPY075 **HEN UCS:** 31220002 **HEN HSAL:** CW3HCPY10	
Description: CORETEMP V3 QUICK CNCT FEEDER CABLE5, 7.5 & 10M **HEN UCS:** 31220042 **HEN HSAL:** CW3HCF05 **HEN UCS:** 31220043 **HEN HSAL:** CW3HCF075 **HEN UCS:** 31220044 **HEN HSAL:** CW3HCF10	 
Description: HPKG HYD CUTTER ASSY HD **HEN UCS:** 80869261 **HEN HSAL:** CW3HHYDCA069	
Description: CW HYD CUTTER REAR SUPPORT **HEN UCS:** 81860921 **HEN HSAL:** CW3HHYDCRS	
Description: CW ROLLER GUIDE ASSY **HEN UCS:** 80908521 **HEN HSAL:** CW3HRG	
Description: CORETEMP FLOW SENSOR **HEN UCS:** 31600294 **HEN HSAL:** CW3CDFS	

13 Appendix: Level Measurement

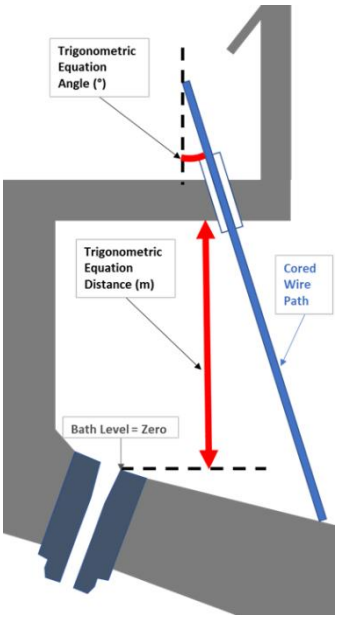
13.1 Introduction

By combining the temperature detection and length tracking data from a CoreTemp measurement it is possible to measurement the steel level of the furnace.

13.2 Level Calculation

13.2.1 Concept

1. The start position of the measurement is at the hot-face of the furnace panel. The assumption is that the cored wire will be given sufficient time to burn away during the processing of the heat.
2. The top of the tap hole is the Zero position. If the bath level is below this level, the calculated level value will be negative.
3. The cored wire will travel from the start position to the bath. The temperature response through the movement will allow for the determination of the steel position relative to the start position.
4. The bath level is calculated using the inputs of the cored wire entry angle and the height of the furnace from the hot-face to the tap hole.



13.2.2 Trigonometric Equation

Heel height = **CF** * (**Distance** + (**Offset** / **CF**) + (**Tilt Factor** * (**Reference Angle** - **Tilt**)) - (COS (**Angle**) * cored wire fed (m)))

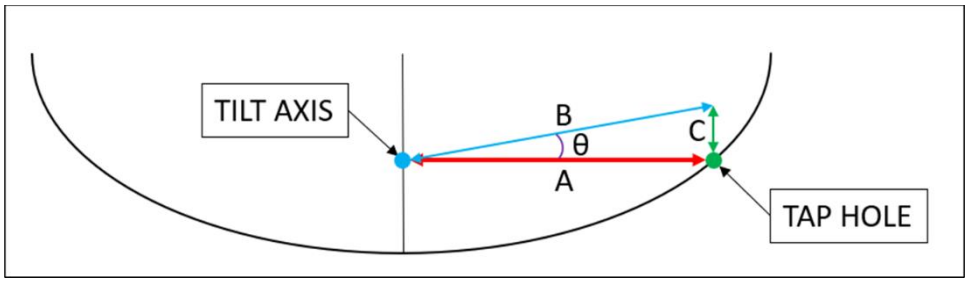
1. **CF** = conversion factor (ex. converting m to in, m to cm, etc.)
2. **Angle** = angle of cored wire entry in degrees
3. **Distance** = vertical distance from the tap hole to the cored wire entry on the EBT panel, in meters
4. **Offset** = Furnace height calibration offset sent via Level I/II (in displayed units)
   a. Offset value is converted into meters in the conversion equation, so the value should be sent in the same units as the displayed result.
5. **Tilt Factor** = Value from Tilt Compensation Factor setting
6. **Reference Angle** = Value from Reference Tilt Angle setting

7. **Tilt** = Furnace tilt at end of level measurement

13.2.3 Tilt Compensation

Parameters are available to utilize the furnace dimensions to allow for measurements at different degrees of furnace tilt to be normalized to the same reference point.

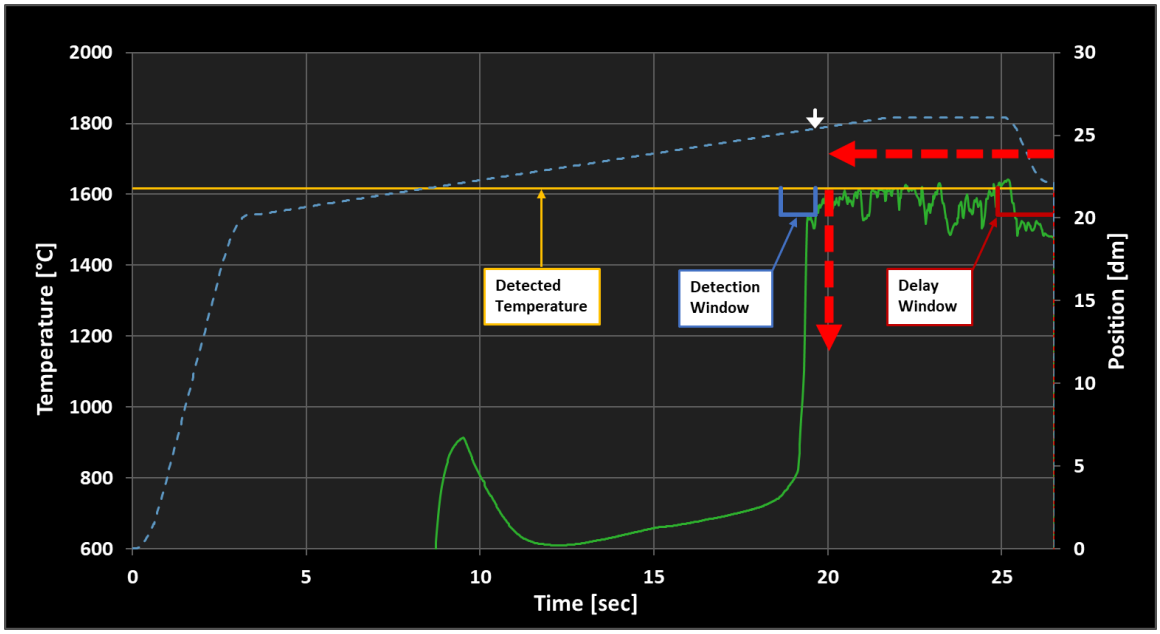
1. **Landing Point Distance** = Horizontal distance from the cored wire landing point to the tilt axis of the furnace (m)
   a. *Setting the Landing Point Distance to Zero, will disable tilt compensation.*
2. **Tilt Compensation Factor** (m/°, Calculated by the CoreTemp Software) = Landing Point Distance * TAN(1°)
3. **Reference Tilt Angle** = The angle to which all measurements should be normalized to (°)



13.3 Trace Evaluation

The CoreTemp Software analyzes the temperature trace to determine the point that the cored wire contacted the steel bath.

1. The measurement must have returned a temperature result in order for a level to be detected.
   a. If the trace does not detect that the bath was reached (i.e. Cold Measurement) the level result will be calculated based on the profile length at the end of the Slow Feed.
2. The algorithm evaluates the temperature samples below the detected temperature by the amount of the **Delta Temperature** parameter.
3. Starting from the end of the measurement, working back to the start, a number of samples (set by the **Sample Count Delay** parameter) must be accumulated in the temperature range (Detected Temperature – Delta Temperature).
4. After the delay is satisfied, the algorithm continues to search towards the beginning of the measurement for a point where no temperature samples are found in the window defined by the **Sample Count Width** and temperature range (Detected Temperature – Delta Temperature).
5. The bath detection is defined by the start of the Detection Window (consider that the algorithm searches the trace from back to front).



On the CoreTemp HMI, the bath detection level is visualized by a vertical, white dotted line.
The calculated level at any point in the measurement profile can be seen by hovering over the displacement line.

13.4 Measurement Suppression

13.4.1 Tilt Suppression

To ensure that the bath level is stable the CoreTemp Software can disable level measurements based on the furnace tilt data sent by Level I/II

1. The furnace tilt must be with the **Minimum / Maximum Tilt Range**
2. The furnace tilt must not change more than the **Tilt Tolerance** for the length of the **Stable Tilt Time**

13.4.2 Furnace Power Suppression

Level measurements taken with power-on can be significantly higher than measurements taken with power-off, so it is possible to require a **Power Off Delay** before a level measurement can be initiated.

13.4.3 Homing Suppression

In order to repeatably measure the bath level the cored wire should start each measurement from a fixed position.

13.4.3.1 Without a Homing System (No Hydraulic Cutter)

The start position of the measurement is at the hot-face of the furnace panel.

1. To allow for sufficient time to burn away during the processing of the heat a **Bath/Heel Level Waiting-Time** can be configured.
2. **Homing Required** should be unselected.
3. In the Homing Menu, **Enable Cutting** should be unselected and **Cut Timing** should be set to After Measurement.

13.4.3.2 With a Homing System (Hydraulic Cutter)

The start position of the measurement is at the end position of the Homing Profile.

1. If Cutting Active is selected, the **Bath/Heel Level Waiting-Time** will be bypassed.

13.5 Example Parameters

Application with Bath Level Measurement without Hydraulic Cutter:

Parameter Category	Setting	Value	Comment
Homing - Homing parameters	**Homing settings**		
Homing - Homing parameters	Enable homing	No	
Homing - Homing parameters	Enable sensor	No	
Homing - Cutting System	**Cutting system activation**		
Homing - Cutting System	Enable cutting	No	
Homing - Cutting System	**Measurement types**		
Homing - Cutting System	All	No	
Homing - Cutting System	**Control logic options**		
Homing - Cutting System	Cut timing	After	For Level Suppression without cutter
Homing - Homing parameters	**Cut detection**		
Homing - Homing parameters	Enable cut detection	No	
Level Measurement - Level Parameters	**Equations**		
Level Measurement - Level Parameters	Selected equation	Trigonometric	
Level Measurement - Level Parameters	Trigonometric equation settings		
Level Measurement - Level Parameters	Conversion factor (inch to meter)	100	Level reported in centimeters
Level Measurement - Level Parameters	Distance (Hot Face to 0-Reference)	1.30	
Level Measurement - Level Parameters	Angle (Degrees)	6°	Wire is angled toward the center of the furnace
Level Measurement - Level Parameters	**Visualization**		
Level Measurement - Level Parameters	Result display unit	cm	
Level Measurement - Level Parameters	Result display precision	x	
Level Measurement - Level Parameters	**Level Offset**		
Level Measurement - Level Parameters	Enable Level Offset	No	
Level Measurement - Level Parameters	Level offset value from Level 2	0	
Level Measurement - Level Parameters	Landing Point Distance	0.0 m (Furnace does not tilt in operation)	horizontal distance from landing point to tilt axis
Level Measurement - Level Parameters	Tilt Compensation Factor	*0.0 m/°*	
Level Measurement - Level Parameters	Reference tilt angle	0 °	

Parameter Category	Setting	Value	Comment
Level Measurement - Bath Level - Bath level parameters	**Bath Level settings**		
Level Measurement - Bath Level - Bath level parameters	Enable bath level	Yes	
Level Measurement - Bath Level - Bath level parameters	Show bath level button	Yes	
Level Measurement - Bath Level - Bath level parameters	**Tilt range settings**		
Level Measurement - Bath Level - Bath level parameters	Min. tilt range	-1 °	
Level Measurement - Bath Level - Bath level parameters	Max. tilt range	1 °	
Level Measurement - Bath Level - Bath level parameters	Tilt tolerance	2.1 °	
Level Measurement - Bath Level - Bath level parameters	Tilt stabilization time	15 s	
Level Measurement - Bath Level - Bath level parameters	**Suppression Settings**		
Level Measurement - Bath Level - Bath level parameters	Bath level waiting-time	90 s	This is the minimum recommended wait time
Level Measurement - Bath Level - Bath level parameters	Homing required	No	
Level Measurement - Bath Level - Bath level parameters	Power Off Delay	0	
Level Measurement - Bath Level - Bath level parameters	**Bath level detection**		
Level Measurement - Bath Level - Bath level parameters	Delta temperature	50°C	
Level Measurement - Bath Level - Bath level parameters	Sample count width	25	
Level Measurement - Bath Level - Bath level parameters	Sample count delay	100	
Level Measurement - Bath Level - Bath level parameters	Cold threshold	2700 °F 1482 °C	
Level Measurement - Bath Level - Bath level parameters	Cold percentage	87 %	
Level Measurement - Bath Level - Profiles	**Profile**		
Level Measurement - Bath Level - Profiles	Bath level	Pre Retract **0** m @ **0** m/min Fast **0.8** m @ **40** m/min Slow **0.75** m @ **6** m/min Wait **2** s Retract **0.4** m @ **30** m/min	Fast Feed should stop before contacting the bath.
Level Measurement - Bath Level - Profiles	**Dynamic Profile**		
Level Measurement - Bath Level - Profiles	Dynamic profile active	No	

Parameter Category	Setting	Value	Comment
Level Measurement - Level prediction	**Visualization level axis**		
Level Measurement - Level prediction	Min. Level axis value	-50	
Level Measurement - Level prediction	Max. Level axis value	100	

14 Appendix: Ladle Furnace Application

14.1 Introduction

The CoreTemp System can also be utilized for temperature measurement on ladle furnace applications. The unique aspects of this application is described here.

14.2 Measurement Procedure

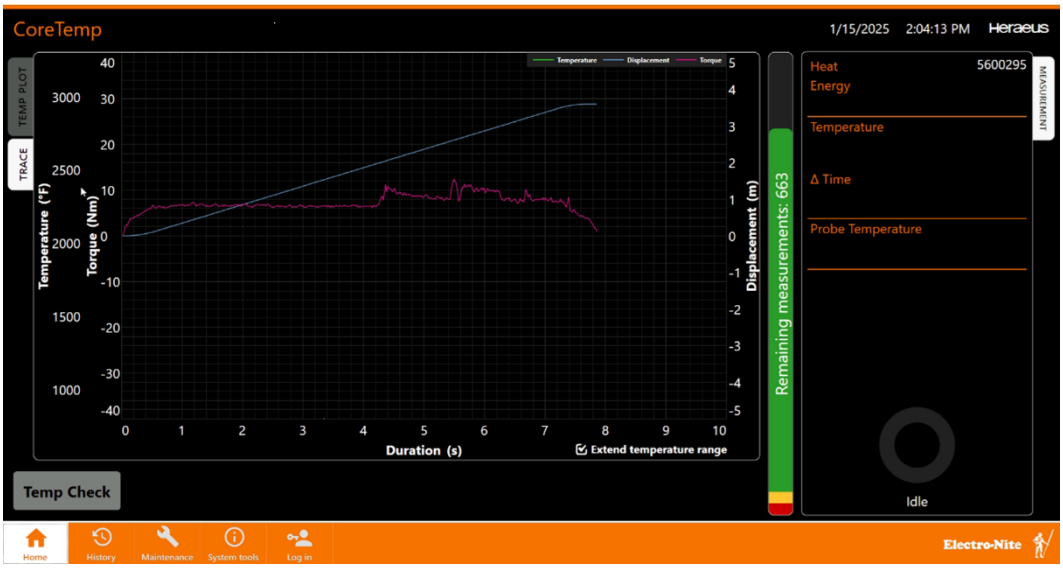
The measurement process is initiated by pressing the ‘Temp Check’ button.

!	**Important Note:** • The cored wire will not be able to penetrate a hard slag layer. • It is recommended to take measurements during power/stir-on or just after these processing actions to ensure the slag layer is fluid.

14.2.1 Freeboard Detection

In order to account for variation in bath level in the ladle, the CoreTemp System utilizes a ‘freeboard’ detection method, where the cored wire is advanced according to a set profile until either the end limit of the profile is reached or the temperature threshold is exceeded.

- If freeboard profile does not reach the temperature threshold, then the cored wire will immediately retract. If the freeboard profile is displayed at the end of the measurement attempt, this indicates that the temperature threshold was not reached.

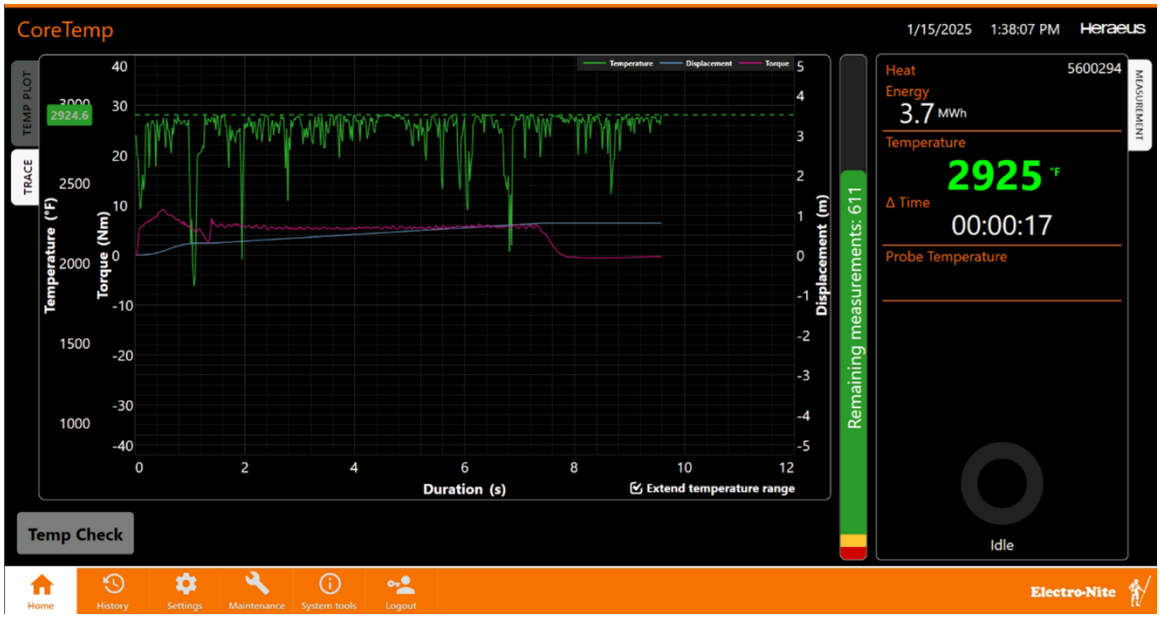


- If freeboard profile does reach the temperature threshold, then the multi-dip measurement sequence will be initiated.

14.2.2 Multi-Dip Measurement Sequence

The actual temperature measurement will occur during the multi-dip sequence.

Depending on the system configuration, a number of measurement attempts may occur during this stage of the measurement process. In the recommended application of the system, the multi-dip sequence will end and display a result once a defined measurement quality threshold is reached.



14.2.3 Retract

Once the measurement sequence is completed, the cored wire will be retracted clear of the furnace.

The retract distance is defined by the distance required to reach the melt during the ‘freeboard’ detection – typically with an offset to account for wire consumed during the detection phase.

The trace from the retract step is never displayed on the CoreTemp Software Home Screen.

14.3 Installation Guidelines

14.3.1 Feeder and Coil Layout

When positioning the CoreTemp Feeder and Coil, it is important to consider the expected distance of the 'freeboard' detection.

- If the wire must advance 3 meters to reach the melt, then the wire will also retract 3 meters after the measurement.
- If the CoreTemp Coil is placed at a close distance behind the Feeder, there is a risk that the cored wire could become entangled with the CoreTemp Coil. This concern is also valid for other equipment located directly behind the CoreTemp Feeder.

14.3.2 Guide Pipe Configuration

The CoreTemp Cored Wire tends to hold the shape of the pipes that it is pushed through.

- If the cored wire is pushed through a pipe with a small bend radius, then the cored wire will keep that radius after exiting the pipe. This can cause a problem with achieving a consistent landing point within the ladle (or even landing in the ladle at all).
- It is important to keep the guide pipes as straight as possible and utilize the largest possible radius on all bent guide pipes.
- If it is not possible to keep the minimum radius larger than 2 meters, then it is possible to utilize a wire straightener after the curved guide pipe sections, but this is not the preferred application.

14.4 Example Parameters

Parameter Category	Setting	Value	Comment
Multi-Dip - Multi-Dip Parameters	**Calculation Conditions**		
Multi-Dip - Multi-Dip Parameters	Minimum number of dips	1 #	
Multi-Dip - Multi-Dip Parameters	**Initial Multi-Dip parameters**		
Multi-Dip - Multi-Dip Parameters	Outlier detection calculation	1.5 #	
Multi-Dip - Multi-Dip Parameters	Minimum quality rating	50 000 #	
Multi-Dip - Multi-Dip Parameters	**Dynamic Multi-Dip parameters**		
Multi-Dip - Multi-Dip Parameters	Dynamic Multi-Dip enabled	Yes	
Multi-Dip - Multi-Dip Parameters	Dynamic result minimum	80 000 #	
Multi-Dip - Profiles	**Sequence**		
Multi-Dip - Profiles	Interdip Time	1	
Multi-Dip - Profiles	Repeat 1st Profile	1	
Multi-Dip – Profiles	Repeat 2nd Profile	2	
Multi-Dip - Profiles	**Options**		
Multi-Dip – Profiles	Show Profile Side Panel	No	

Parameter Category	Setting	Value	Comment
Multi-Dip - Profiles	**Profile**		
Multi-Dip - Profiles	Selected Profile	**Low**	
Multi-Dip - Profiles	Low - First	Pre Retract **0** m @ **0** m/min Fast **0.3** m @ **30** m/min Slow **0.5** m @ **5** m/min Wait **2** s Retract **0** m @ **0** m/min	
Multi-Dip - Profiles	Low - Second	Pre Retract **0** m @ **0** m/min Fast **0** m @ **0** m/min Slow **0.3** m @ **6** m/min Wait **3** s Retract **0** m @ **0** m/min	
Freeboard - Freeboard parameters	**Freeboard settings**		
Freeboard - Freeboard parameters	Enable freeboard feed	Yes	
Freeboard - Freeboard parameters	Threshold temperature	2500 °F	
Freeboard - Freeboard parameters	Time above threshold	100 ms	
Freeboard - Freeboard parameters	Retract velocity	30.00 m/min	
Freeboard - Freeboard parameters	Retract trim	-0.30 m	Negative value retracts less than freeboard feed
Freeboard - Profiles	**Profile**		
Freeboard - Profiles	Freeboard	Initial **0** m @ **0** m/min Fast **0** m @ **0** m/min Slow **2.6** m @ **25** m/min	Threshold detection is only active during 'Slow' feed